

THE HIGH COST OF CHEAP CONSTRUCTION



A BOOK FOR HOME BUILDERS
ON THE IMPORTANCE OF RIGHT
CONSTRUCTION IN HOUSE BUILDING

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A BOOK FOR HOME
BUILDERS ON THE
IMPORTANCE OF
RIGHT CONSTRUCTION
IN HOUSE BUILDING

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Courtesy Samuel Chamberlain

ISAAC TUCKER HOUSE—1789

MILTON, MASS.



Courtesy Samuel Chamberlain

JOHN QUINCY ADAMS' BIRTHPLACE—1716

QUINCY, MASS.



Courtesy Samuel Chamberlain

GRISWOLD HOUSE—1750

GUILFORD, CONN.



Courtesy Samuel Chamberlain

GOLDEN BALL TAVERN—1753

WESTON, MASS.

A BOOK FOR HOME BUILDERS
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CONSTRUCTION IN HOUSE BUILDING

This

BOOK, if it is to be of value, must be truthful and frank. If there have been failures in house building in recent years, if unsatisfactory houses have been built, there can be no valid reason for concealing the real facts. So this book starts out with the admission that all house building ventures have not been successful. Leaky roofs, bulging walls, squeaking stairs, sagging floors, cracked plaster, draughty or rattling windows and doors are results of poor construction. Short life, quick depreciation, high repair costs and low resale values come from construction short-cuts not recognized by first-rate home-builders.

It is, therefore, the purpose of this book to assist you in identifying good construction. Through your insistence upon good lumber and right methods of construction, your house will be substantial — comfortable to live in and economical to maintain through the years.

Good workmen and the better class of building contractors have been preaching and practicing good construction for years. This book, therefore, contains nothing startlingly new; any good contractor, carpenter or craftsman might have written it. If it impresses the prospective builder with the desirability of investigating corners before cutting them; if it instills in him a greater appreciation and knowledge of thorough craftsmanship and helps to forestall needless failures and annoyances, then it will have accomplished its purpose.



WEYERHAEUSER SALES COMPANY

THE HOUSE THEY DIDN'T BUY

SEVERAL YEARS ago in a small Illinois city, a Dutch Colonial house just completed, created a great deal of favorable comment. Couples of all ages exclaimed about it as they passed. Even the town's most stolid citizens were taken with its quaintness and simplicity. Those who had been inside of it marveled at the convenience of its interior arrangement. Here at last was a sensible, easily-kept house, good looking outside and in; with apparently every convenience necessary to appeal to the popular fancy.

The outside was finished with hand split shakes and the house was framed with lumber as are the great majority of houses, whether their exterior finish be of wood, stucco or brick veneer.

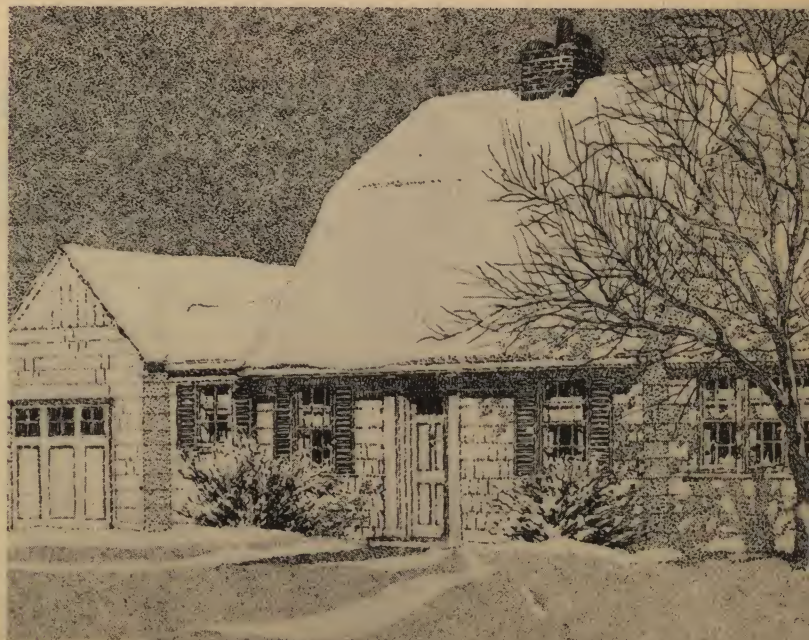
A few years later this house was offered for sale at what seemed to be a very reasonable price. The "For Sale" column of the newspaper carried the usual list of appointments and conveniences. There was a sun room and a breakfast nook in addition to six other rooms and bath. Of built-in features there were many—built-in bookcases, linen closet, kitchen cabinets, recessed refrigerator, a game room. These alone would have sold the house. The bed rooms were finished in white enamel; the closets large; the floor of hardwood. In the basement there were stationary tubs, vegetable room, the latest type of automatic water heater and a hot water heating plant. And

to top it all off there was an attractive garden treatment in the rear.

A Mr. Wieland later confessed that for two years he had admired this house and wanted one like it. He had a wife and two small children. The house exactly fitted their needs. He had saved enough money to purchase it.

He began to worry lest the house be sold before he could get to it, yet he was deterred from closing the deal on the spot, as he relates the incident, by the suggestion of his wife that it might be wise to get an old friend of the family, a retired contractor, to look over the house with him before the money was paid over.

The following day, Wieland, who was already picturing his shins toasting before an open log fire in the cozy living room, hustled the contractor through the house, pointing out its many virtues and taking for granted that his friend could not be anything but favorably impressed. The first



intimation he had that his friend did not share his enthusiasm came when the contractor bluntly remarked that the house was one of the "short-life, quick-depreciation variety." He added that in his opinion it would be an expense at half the price. Then, just for good measure, he proceeded to prove his statement.

Let us see just what happened — the information might be enlightening to the home-builder and to the neophyte in house buying as well.

In the basement where before the light-hearted prospective purchaser had seen only the beautiful laundry and the handsome game room, Mr. Michaels pointed out that the floor was damp and that the walls fairly dripped with moisture. Lack of rain leaders and improper drainage around the foundation wall were cited as the cause. Next, a small crack in the front foundation wall which had gone unnoticed on the first trip was called to Wieland's attention. It had undoubtedly developed because of uneven settling in the footings under the foundation. Sam Michaels explained that by digging down so as to expose these footings, it would be found they were either

too small or made of a poor concrete mixture. What's more, he added, the settling would undoubtedly continue, the crack in the wall would grow larger and spread to the plastered wall overhead if it had not already done so.

THE CONTRACTOR found a streak of daylight around the basement sash frames. He pictured big fuel bills and a draughty basement. Mr. Michaels also explained that the bearing post should have been set up a few inches off the floor to prevent deterioration resulting from the absorption of moisture. He showed Wieland a crack in the basement floor indicating that there had been further skimping in the concrete mix.

Wieland was surprised to learn that the length of the floor joists was partly responsible for squeaking floors. In this house the joists were 2x8, but the span was 14 feet. For such a span 2x10 joists should have been used. Therefore the joists had already begun to sag, causing loosening of nails in the floor. Sure enough when Wieland later walked on the floor above, he heard the squeak which the contractor had predicted.

The wood braces criss-crossed between the joists also caught Michaels' attention. The nails were only partly driven, and the pieces were not securely fastened. Wieland was informed that bridging, to be of any use, must be carefully fitted and tightly nailed.

While they stood looking up at the floor joists, the contractor observed that it would have cost but little more to lay the sub-floor diagonally with the joists. As it was,



both the sub-floor and the finish flooring ran in the same direction, with the inevitable result that cracks and waves would be found in the finished floor. They ascended the cellar steps. The contractor opened the outside kitchen door, and they stepped out on the sagging stoop. Michaels said that sagging was caused by footings of insufficient depth.

THEY RETURNED to the kitchen, and the contractor slammed the door shut with a bang. The door flew open again, the latch having refused to hold. With a cynical smile that seemed to anticipate this very occurrence, the contractor closed the door again; this time carefully and lifting it slightly. The latch caught; the door stayed closed. Wieland learned that the cause of the door's misbehavior could be laid to the sagging of the door frame and that this could be traced to the uneven settling of the wall due to those faulty footings of the foundation.

Throughout their inspection of the first floor rooms, Michaels was busy pointing out opened joints in the woodwork, warped doors, stained and cracked plaster; defects which had had little significance to Wieland. Special attention was drawn to water marks under the window and white spots on the varnished floor beneath the window, caused by rain driving in between the window sill and stool. Dust streaks on the plastered walls around the window casings suggested draughty windows and excessive fuel bills. CRACKS in the plaster over the arch

between the living and dining rooms told a story of misdirected economy. Under-sized framing material, lack of trussing and improper construction were hidden behind the plaster over this opening.

After Michaels had vainly endeavored to raise one of the windows, he made his way in disgust to the front door. On their way up town, he summed up his observations: "Wieland, this house is a good example of almost everything a house ought to be except the one thing that gives it long life and comfort. Cheating on the construction of a house is like robbing a child of its health. I was a builder myself, and I'm against this kind of shoddy, unworkmanlike construction because it makes a lot of unsuspecting house buyers lose confidence in the trade.

"A man buys a house like this one once — then if excessive fuel bills and repair costs and depreciation haven't taken all his money, he builds one and builds it right. Do you know that you can build a home that is structurally correct and which contains all the attractive features you liked in this one for no more than the price of that horrible example we just left?"



WHY SO MANY FAILURES IN HOUSE BUILDING



THE INCIDENT just related is an isolated one, yet the house described is, with some variations, like "Main Street," to be found in almost every village, town and city in the country. What is the cause of this condition — is house buying or home-building really such a gamble? The answer is not complicated, rather it is very simple.

A well-known contractor said that the chief breeder of shoddy structures, unwarranted repair bills and short-lived houses, is the lack of appreciation of the value of right construction in house building on the part of the owner. The average man purchases a pair of shoes and judges them by the amount of wear he can get out of them. In buying a motor car he will inquire about the engine, the brakes, the gas consumption and other details. Then let this same purchaser start out to build a house.

Immediately he discards his old purchasing habits. The manner in which the house is built is apparently of little moment to him. The completed house must look well. Aside from that, anybody's construction standards will do as long as they will give him the house he wants in the shortest pos-

sible time and at the least cost. Here is the biggest purchase of a lifetime — the one which he knows least about, the one which undoubtedly means most to him, the one that will be with him the longest — treated as an insignificant article on the bargain counter.

LITTLE WONDER that there is a class of builders with low prices their principal stock in trade — with construction standards of questionable merit. It is not the intention to imply that the lavish spending of money is necessary to insure the owner a satisfactory home. There are economies that can be and should be practiced in house building. The legitimate contractor knows these economies and knows how to apply them properly.

It is well for any prospective builder to bear in mind that the history of a house is written not alone on the first purchase price but also on future maintenance cost. Fifty dollars saved today by cheapening the construction of a \$5,000.00 house may return as a "five-times-\$50" repair bill in a short time. This book is presented to assist you in recognizing good construction and in obtaining permanent satisfaction.

HOW TO OBTAIN A *Substantial* HOME

NO HOME can be thoroughly successful unless it combines four basic essentials: good design, efficient plan, right material and sound construction. A home may be large or small, elaborate or inexpensive. It may be attractively finished and it may boast of every modern convenience and labor-saving device, yet without all four of these essentials it can never be a permanent, substantial and satisfactory home. THE PURPOSE of this book is to treat in simple terms the construction principles and practices that will help to make your house a substantial home. It will show you the means of judging the construction of your home as it is being built; assist you in avoiding endless annoyances and excessive maintenance costs. To the home builder who retains the services of an architect, this book can offer little more than an appreciation for the value of his services. They insure correct design, carefully prepared specifications and intelligent supervision.

If you build without the services of an architect be sure that your house is structurally correct. This book will equip you with information which will qualify you to identify good construction and help you to protect your interests. While details of construction vary in different localities and with different builders, the principles are the same. The better contractors and workmen are thoroughly familiar with approved building practices.

FAILURE to recognize the importance of good construction, or to assume that construction standards of all builders are the same, often results in trouble. Saving a few nails at the cost of squeaking floors, saving a little labor and material at the expense of excessive fuel bills and repair costs, is an expensive economy. With an understanding of good construction and by insisting upon it, anyone may enjoy the comforts of a permanent, economical home.

HARLOW HOUSE

PLYMOUTH, MASS.

Courtesy Samuel Chamberlain





● For the guidance of those who may not be familiar with construction practice or the names given to the various framing members in a house, the house above is shown in this book in five different stages of construction on pages 10, 22, 26, 37 and 49.

It is the purpose of this series of drawings to show the successive steps in the building of a house of the improved Balloon Frame type, and to identify for the inexperienced builder the different members and parts of the structure referred to in the text that follows.

If some of the detail drawings in this book are not altogether clear to you, a reference to this series of drawings will be found helpful.

With a little observation of houses under construction, the building of a house will be readily understood.

THE IMPORTANCE OF *Good Construction* IN HOUSE BUILDING



THE LAYMAN who views a half-finished house is often confused with its maze of framing and scaffolding. House building is not difficult to understand. A house has comparatively few main parts, and its erection is not complicated. CONSIDER this simple grouping of the principal parts of a house frame: the foundation; the floor frame work, consisting of bearing posts, girders and joists; the walls and partitions built of studding; and the roof. All other framing members are incidental to one or another of these parts.

On the following pages, you will find examples of proved construction methods. You will find also some illustrations of poor building practices. An inspection of these illustrations will point out the importance of building correctly.

THE FOUNDATION

THE PURPOSE of the foundation is to support the house. This statement may seem superfluous, perhaps ridiculous.

Yet there are many houses in which defects are traceable to foundations that have failed to perform their full duty. It still holds true that a house is no stronger than its foundation.

Concrete blocks, poured concrete, brick and stone are the materials used for foundations; all are satisfactory when properly used.

Concrete, however, is not a synonym for permanency; there is good concrete and there is bad concrete. The strength of concrete for foundations is dependent upon the use of well-graded sand and gravel, mixed in proper proportions with cement and water. It is important that concrete should be prepared and applied under experienced supervision.

There has been a tendency to cheapen foundation walls by making them thinner than they should be. The thickness of foundation walls is a matter usually governed by local building codes. These codes, and likewise good practice, require walls at least ten inches thick, and in the case of stone or brick walls, sixteen inches thick.



FOOTINGS

FOUNDATION walls are enlarged at their base in order to furnish a larger bearing surface against the soil beneath. This enlarged base is termed "footing." One can readily see that the footings are an important part of the foundation, and particular attention should be paid to their size and shape. In the house where cheapness is the paramount issue, the footings are fre-

quently slighted. It is apparent to the reader that these footings, which must bear most of the weight of the structure, should be carried down to firm ground and below the frost line. The folly of placing them on frozen ground is likewise readily seen.

No end of house ills and annoyances result from improper footings. Poor footings cause uneven settling of the foundation walls, and this in turn is transmitted to the whole house, throwing it out of plumb. The damage is visible inside the house in the form of cracked basement walls, cracked plaster on the upper floor walls, binding doors and windows and sloping floors. Joints in the woodwork will be forced open both inside and outside the house. Nor are these all the evils that can be ascribed to faulty footings and uneven settling of the walls. The pitch of the gutters may be altered, causing water to back up instead of flowing off. This water will overflow the gutters and may back up under the roofing, ruining the housewife's disposition by marring and staining interior decorations. Considerable expense may be involved in redecorating. This annoyance will continue with every thaw or heavy rain until the gutters are repaired or rebuilt. Figures 3 and 4 show good and bad footings and give some precautions that will forestall the house ills described above.

Often footings that are correct in every way are undermined to permit the entrance of service connections and rain leaders. This weakens the footings at this spot and may result in some of the house ills just mentioned. At the places where it is necessary to undermine footings, they should be either enlarged or, better still, reinforced with steel rods.

● The importance of the footings under the foundation wall and bearing posts is apparent in the accompanying illustration. Properly designed footings are shown at points A and B. Note the broad, flat bearing surfaces of these footings. To support the weight of the structure above, all footings should rest upon firm ground.

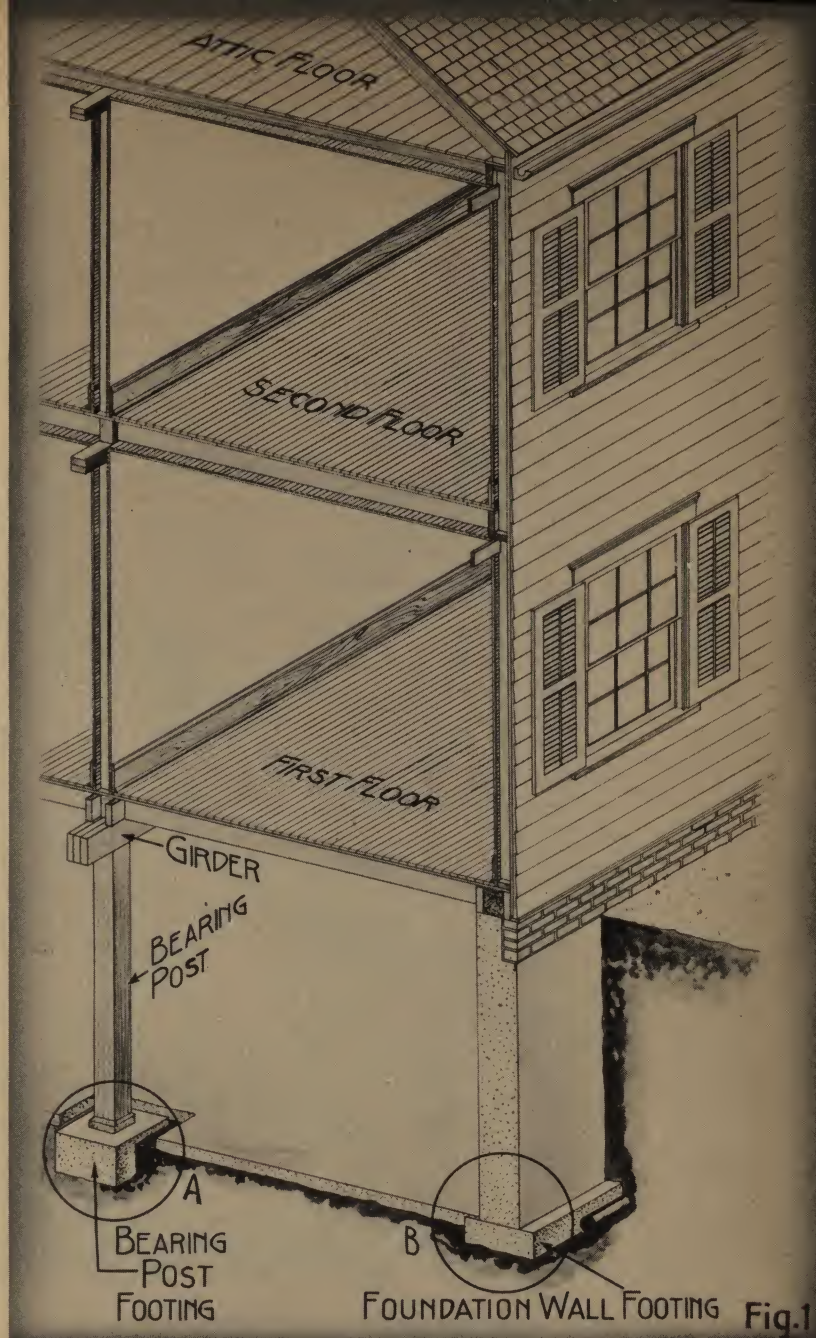
With so many sizes and weights of houses and with such a disparity in the bearing power of various soils, it stands to reason that one size of footing is not suitable for all conditions.

However, it has been found that for the small house with average soil conditions the foundation wall footings (Point B) should extend at least four inches beyond the wall on both sides and should be at least eight inches deep. Likewise, it is a good rule to make the bearing post footings (Point A) from eight to twelve inches deep and from eighteen to twenty-four inches square, depending on the load to be carried and soil condition.

When the foundation is built in damp soil, the site should be drained with four-inch drain tile around the outside of the footings. This should be connected with the sewer or other drainage system.

In excessively damp soil, if a dry basement is to be assured, it is well to waterproof the outside of the foundation wall with a coat of hot pitch or asphalt or a half-inch layer of rich cement mortar.

Figures 4 and 6 show how footings are sometimes neglected.



● This illustration shows the inevitable result of inadequate footings under the foundation wall, a construction fault common in many houses and fully illustrated and discussed on the two following pages.

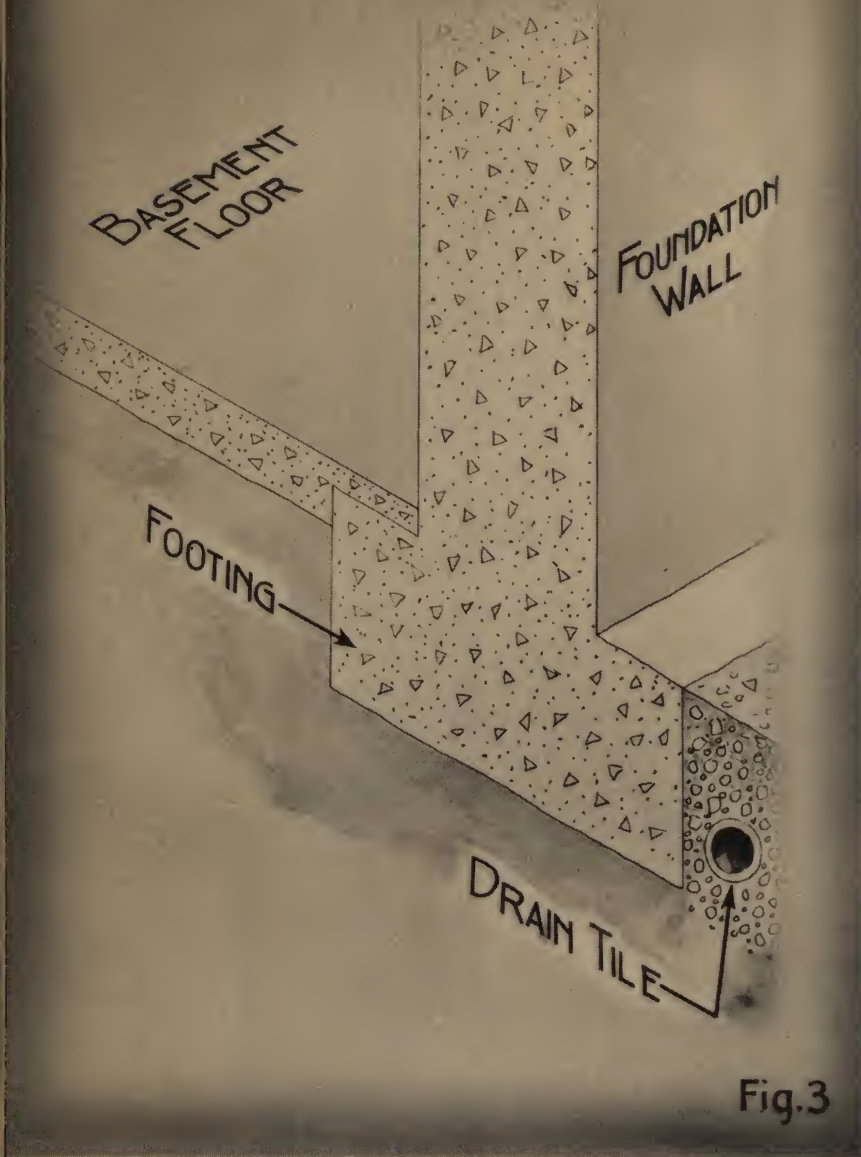


Fig.3

WRONG

Footings that are undersize, with bearing surfaces that are round or wedge-shaped, or that rest on loose, filled-in or frozen soil, are the direct cause of such difficulties as are mentioned in the text on page 12.

RIGHT

This drawing shows in detail a foundation wall footing constructed after approved design.

The drawing below shows the slipshod manner in which footings are sometimes built.

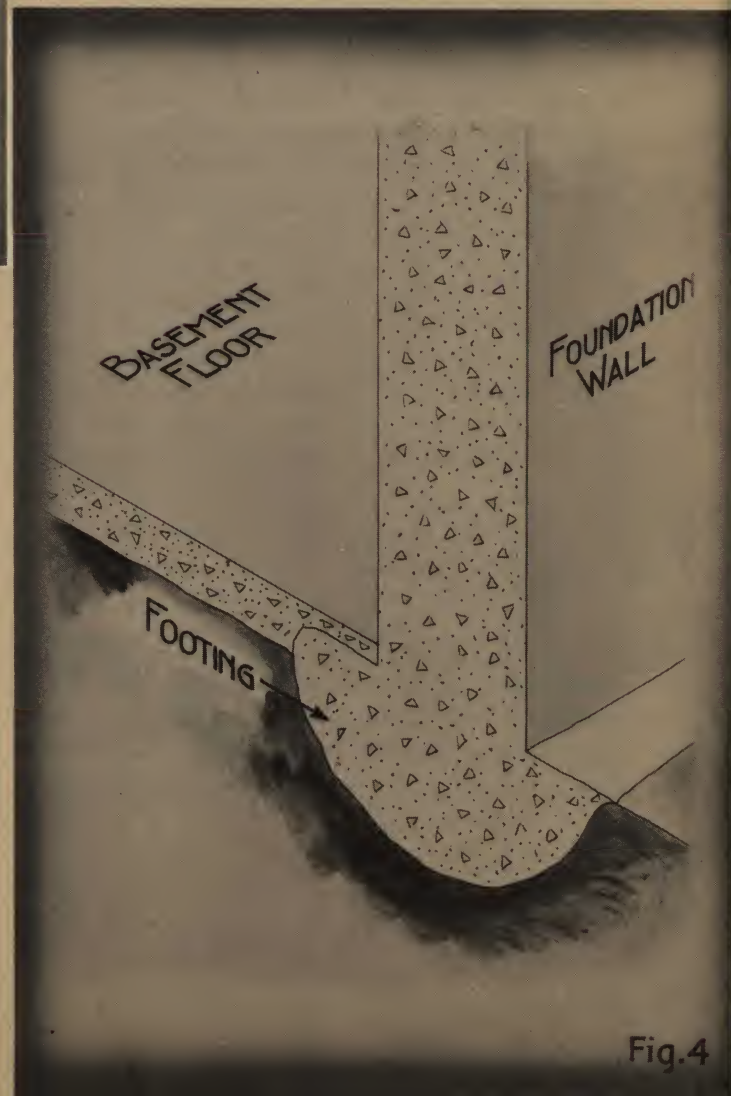


Fig.4

RIGHT

The bearing post footing shown here is properly designed. Note the broad, flat bearing surface to resist the weight from above and note, too, in contrast to the footing shown below, that it is carried up sufficiently above the cellar floor to keep the end of the post dry and sound.

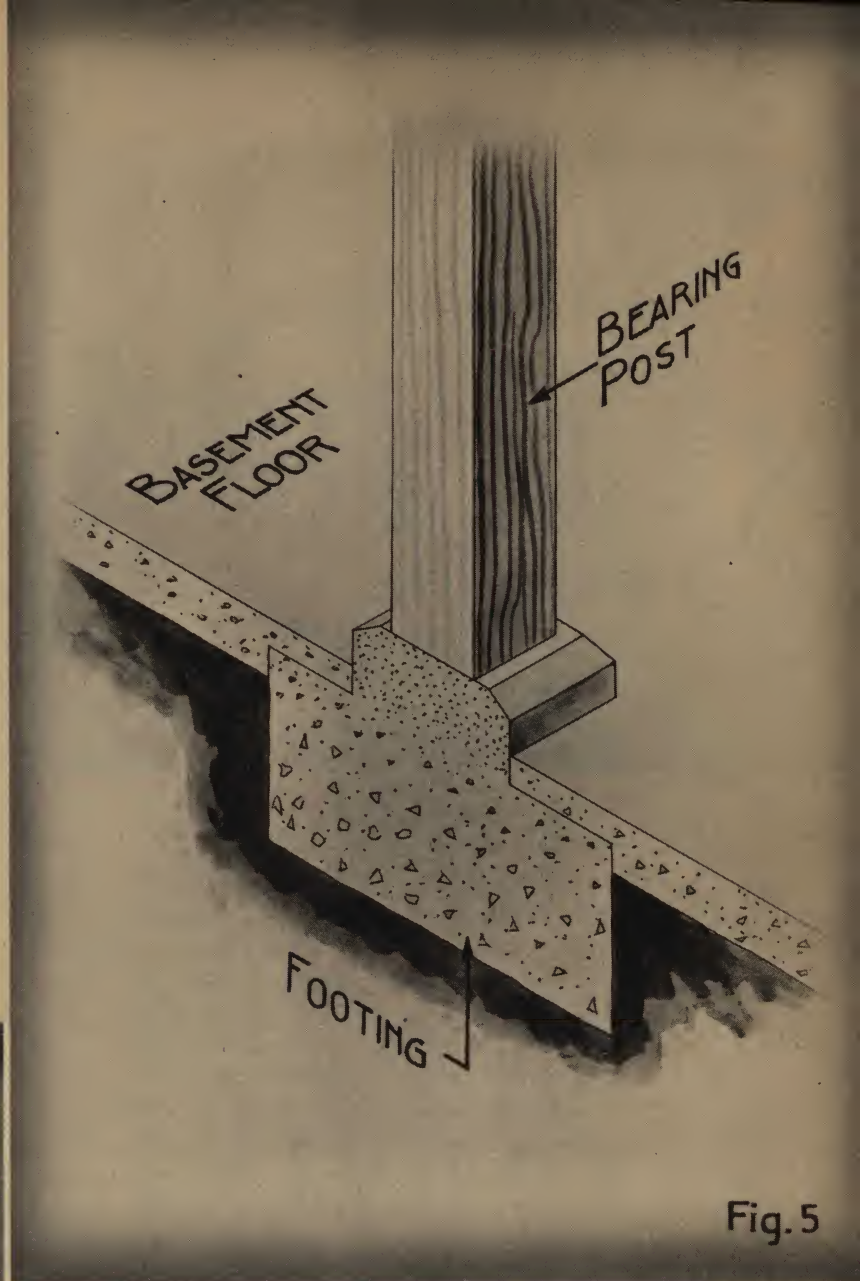


Fig. 5

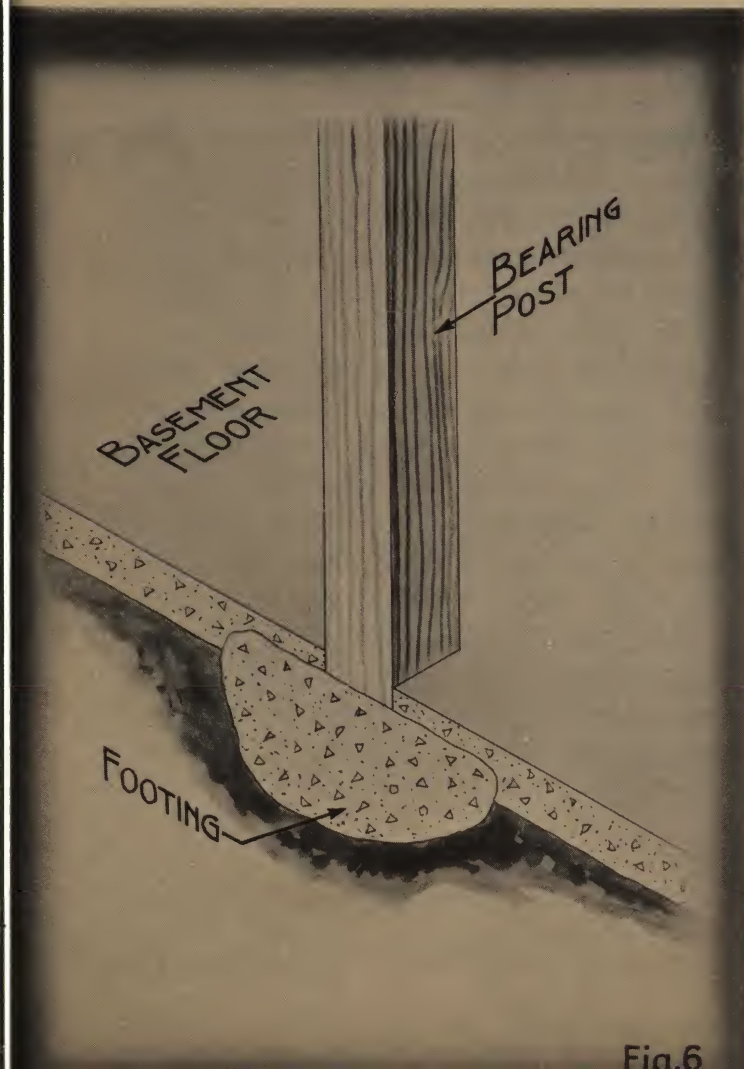


Fig. 6

WRONG

Footing construction such as this leads to house ills.
(See page 12.)



● Sagging porches like the one here shown are the result of insufficient support, again a matter of improper footing. Sometimes very good porch piers settle when service connection trenches are dug too close to them and are not properly refilled. The condition shown in this picture is by no means uncommon. It can easily be avoided by proper attention to footings at the time a house is being built. In a completed house, it is difficult and expensive to remedy.

To avoid the heaving action of the frost, porch foundations should be well footed and should be run down below the frost line.

As a business proposition it is cheaper to build a good house than a poor one. The slight additional cost of building a house right is made up many times over by lower repair costs and higher resale value.

BEARING POST FOOTINGS

THE foundation supports the outside walls and the weight of about half of the floor area. The remainder of the weight of the house is dependent upon the bearing posts for support. The bearing post footings should, therefore, not be neglected. Care should be exercised to see that trenches for water and sewer pipes are not dug close to these footings, as this will have a weakening effect on them.

When bearing posts settle unduly, the effect is apparent throughout the house. Plaster cracks appear on the inside walls, doors and windows become balky, and floors settle at the inner walls. The annoyances that result from uneven floors are familiar to everybody.

Figures 3 and 4 show correct and incorrect ways of building footings for foundation walls and bearing posts.



PORCH PIERS

WORKMEN who would not slight the footings under the foundation walls or those under the bearing posts sometimes fail to realize the importance of the porch piers and their footings. The porch piers are put in for the very practical purpose of supporting the porch; a sagging porch will surely result if the piers are not properly "rooted." Probably no one thing gives a house such a run-down, "hang-dog" look as a "sway back" porch. And appearance, it must be remembered, has a direct effect on the resale value of the house.

The importance of proper foundations, bearing posts, porch piers and their footings cannot be too strongly emphasized, for any settling must of necessity affect the entire superstructure of the house.

TYPES OF FRAMING

THE FRAMEWORK of the house has aptly been termed its skeleton, and its purpose obviously is to give strength and rigidity to the structure. It is not necessary that the prospective builder know all of the details of the various types of framing or, for that matter, the method of constructing the one type he chooses, but the owner will find an acquaintance with house framing invaluable in his effort to secure a good house.

There are many types of house framing in use in various sections of the country, but for practical purposes, they may be grouped into four classes—the Braced Timber Frame, Modern Braced Frame, Balloon Frame, and Platform Frame.

THE BRACED TIMBER FRAME

THE Braced Timber Frame is the oldest type and originated in New England. The early colonists brought with them a tradition of heavy, European half-timber construction, and this was nourished by the abundance of standing timber directly at hand. Nails had to be made by hand; therefore, the early craftsmen used them sparingly, devising methods of fastening that consisted of mortises and tenons held together by wooden dowel pins.

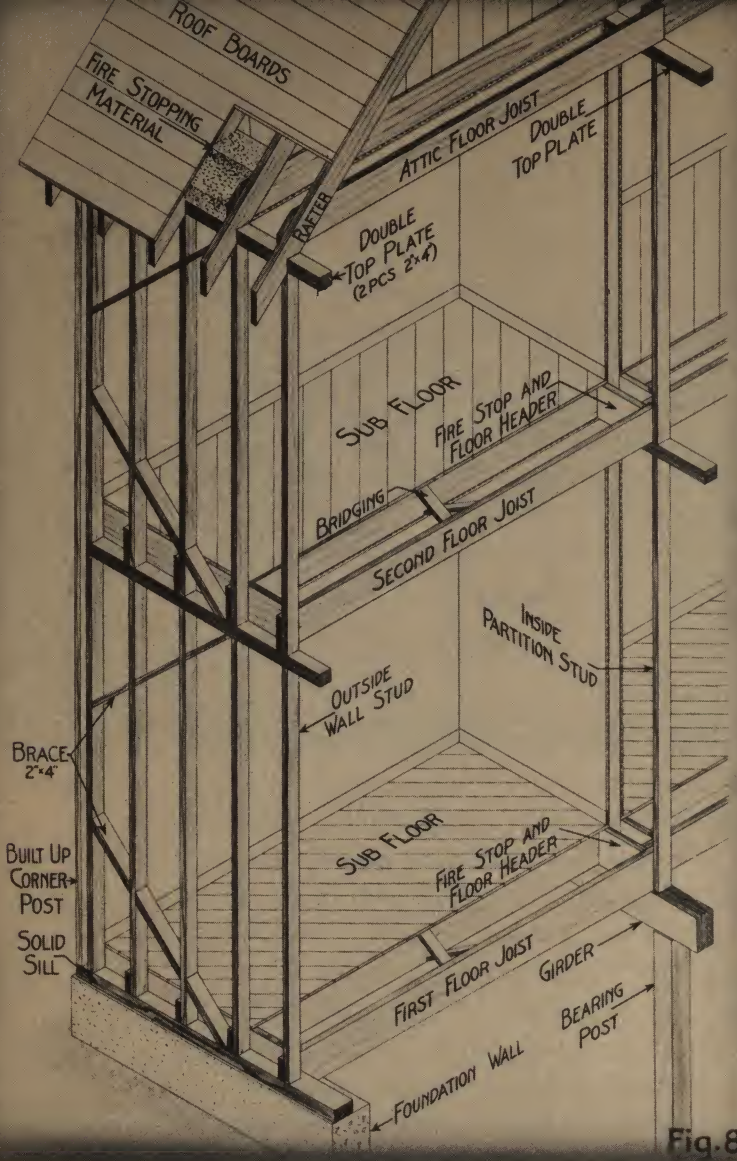
The principal framing members of the old New England houses were often hewn out of the trees nearest at hand and were ordinarily of much larger dimensions than were required to give the necessary strength. The time required in those days to prepare the timbers necessary for the building of a

house, as well as the time required for its building permitted the timbers and framing members to dry out thoroughly before the building was completed. And under these conditions the old Braced Timber Frame resulted in a practically faultless house of which hundreds of old houses still standing in the eastern states today bear evidence.

THE MODERN BRACED FRAME

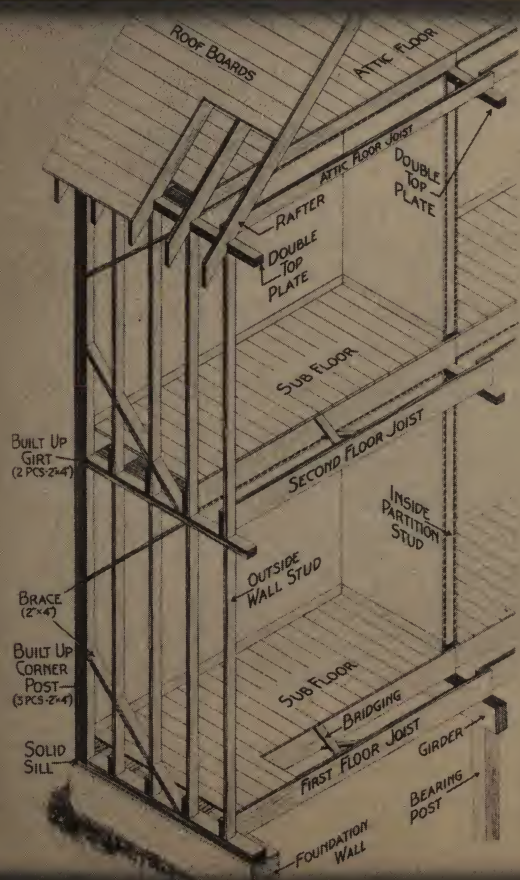
In those sections of the country where many of the old Braced Timber Frame houses still stand, a modern adaptation of the old Braced Timber Frame has been developed. This type of frame is sometimes called the "Combination Frame." Corner posts and girts built up of two or three pieces of two-inch lumber take the place of the solid timbers formerly used. Nails largely replace mortises, tenons, and dowel pins for fastening. With the elimination of the heavy timber girts the intermediate posts formerly required to support them have been done away with, and the studs, in addition to furnishing bearing surfaces for the inside and outside walls, are utilized for support as well. The corner bracing, however, is retained as is in most cases, the solid sill.

This Modern Braced Frame is in every way adaptable to modern building needs, yet to be thoroughly efficient should not be slighted in its construction. This method of framing is shown on page 18—in one case complete as it should be built and in the other case only partially developed at the sacrifice of much of its efficiency.



RIGHT

● The Modern Braced Frame, constructed in this manner, makes an entirely satisfactory and efficient frame. The fire-stops or floor headers of two-inch lumber placed between the floor joists make this frame fire-resistant and vermin-proof, and also make it possible to lay the sub-floor diagonally with the joists, a very important consideration from several standpoints, as will be seen later on in this book. Stops to the passage of fire and heat in the walls are afforded by the girts. Note, too, that the partition studs rest directly upon the girder, a further consideration of importance in eliminating settling due to unequal shrinkage in the walls and bearing partitions.



WRONG

● This illustration shows some common abuses in the construction of the Modern Braced Frame. Floor headers and fire-stopping between the joists have been omitted. For lack of these headers the sub-floor has been laid at right angles to the joists at the expense of the rigidity of the structure and the success of the finished floor to be laid above it. The bearing partitions also rest upon the sub-floor with the result that these inside walls will settle as the joists, sub-floor boards and plates dry out and shrink under the artificial heat inside the house.

Fig. 9

THE BALLOON FRAME

THE Balloon Frame is another modern and accepted type of framing applicable to the building of substantial houses in all parts of the country. As is the case in the Modern Braced Frame, it is built almost entirely of two-inch lumber. Nails are also used for fastening in place of mortises and tenons. The distinguishing feature of the so-called Balloon Frame, however, is that the wall studs are made to extend up two stories high with the ends of the second floor joists spiked to their sides and resting upon a false girt or "ribbon board" which is notched into them on the inside. A box sill is ordinarily used with this type of framing. The elimination of the girts in the walls has required the fitting of fire-stops between the studs to prevent the circulation of air throughout the walls. Floor headers and fire-stops between the joists accomplish a similar purpose. The sub-floors are laid diagonally with the joists. The bearing partition studs rest upon the girders. Corner bracing is also required unless the sheathing is applied diagonally.

The Balloon Frame offers the advantages of speed and economy. It also possesses excellent rigidity. Properly constructed, it is in every way to be recommended and is rapidly coming into greater and greater favor.

It is unfortunate that so logical a type of framing should be so grossly abused by careless builders in their over-zealous quest for speed and cheapness. It seems to have developed in two diametrically opposite directions. In the one case it has been improved to the point where it meets successfully all the demands of efficient building practice. In the other case it has been cheapened through harmful "corner-cutting" into a flimsy, short-lived structure. That you may appreciate the good points in the properly

constructed Balloon Frame and, at the same time, guard against the construction abuses to which it is often subjected, it is shown in both its good and bad forms on the following page.



THE PLATFORM FRAME

THE disregard by many builders of one very important consideration in the construction of a house frame has led in recent years to the development of a newer type of frame called the Platform Frame. During the life of a house the lumber of which it is constructed undergoes many variations of temperature and humidity. Even seasoned lumber will be further dried out under the artificial heat in a house in winter, and, as its moisture content is reduced, it will shrink somewhat. This shrinkage in lumber, however, occurs across the grain rather than with the grain; that is, the shrinkage in the lumber lengthwise is negligible, while the shrinkage across the grain is often quite marked, depending upon its moisture content at the time it is set in place. Therefore, you will note that in the properly designed Balloon Frame and Modern Braced Frame, already illustrated, the amount of horizontal framing lumber subject to shrinkage has been reduced to a minimum in the walls and bearing partitions, in an effort to eliminate, as far as possible, the settling that will occur as the lumber dries out.

In the Platform Frame the amount of horizontal framing lumber in the outside walls and inside bearing partitions has been equalized. This frame, however, accomplishes its end not through a reduction in the amount of cross sectional lumber subject to shrinkage but by the addition of more. It also lacks some of the stiffness found in the other two types just discussed.

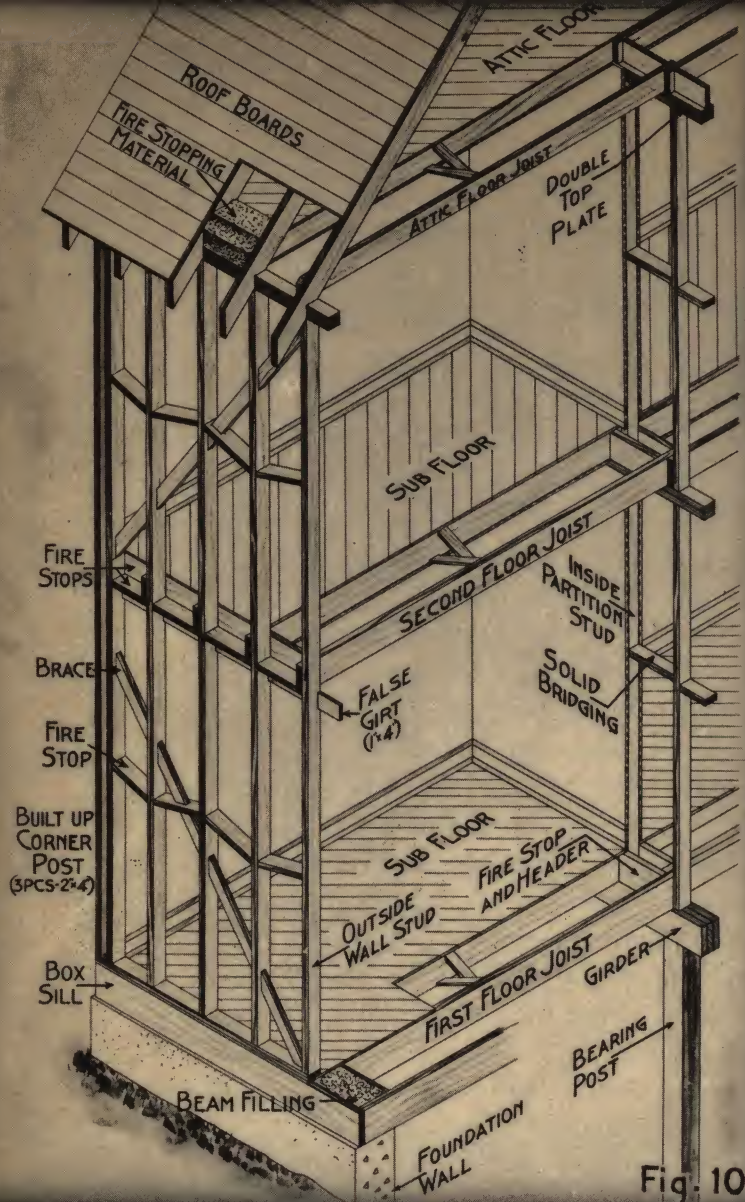


Fig. 10

RIGHT

● Because the Balloon Frame has qualities and advantages that cannot be found in other types, conscientious builders everywhere have striven to build 100 per cent efficiency into this type of framing, with the result that today it is an eminently satisfactory frame from every standpoint.

Wall and corner studs, continuous from sill to plate, make for stiffness, corner braces and fire-stopping in the walls and floors for rigidity, and fire-resistance, while by reducing as well as equalizing as far as possible the amount of cross sectional lumber subject to shrinkage in the inside and outside walls, the problem of plaster cracks and other ills traceable to shrinkage is largely solved.

Nor are these improvements of the kind that add greatly to the cost, in either time or material. In fact, the difference in the cost of a good Balloon Frame over that of a poor one is so small, when compared to the added efficiency, that it is surprising to find it so grossly misused.

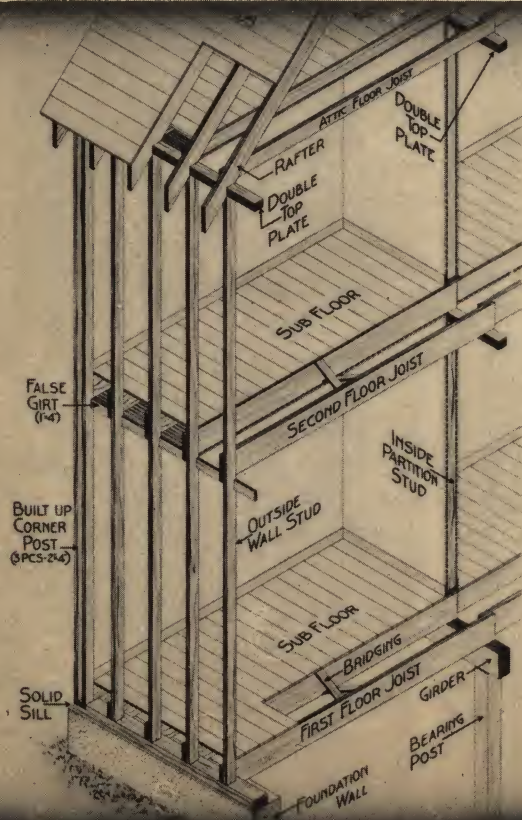


Fig. 11

WRONG

● This illustration shows how even the best method of framing a house may be reduced to total inefficiency by cutting the corners and cheapening its construction. Unfortunately, many so-called Balloon Frame houses are constructed in this manner. The elimination of corner braces robs the structure of much of its rigidity. The ready circulation of air between walls and floors is also responsible for serious heat losses in the finished house. A prediction of plaster cracks, squeaking floors and numerous other house ills is apparent in this cheapened frame.

PLATFORM FRAME

● In this type of frame the first floor is built on top of the foundation walls as though it were a platform. The outer ends of the floor joists rest on a sill, of combination type, while the inner ends rest on an I-beam upon which has been placed a two-inch plank. On the floor joists is nailed the sub-floor, laid diagonally.

The wall and partition framing is then run up another story to support another platform for the second floor. Again, the third or attic floor consists of a third platform built upon the second floor wall and partition framing, thus making the whole a series of platforms each supported by independent partitions.

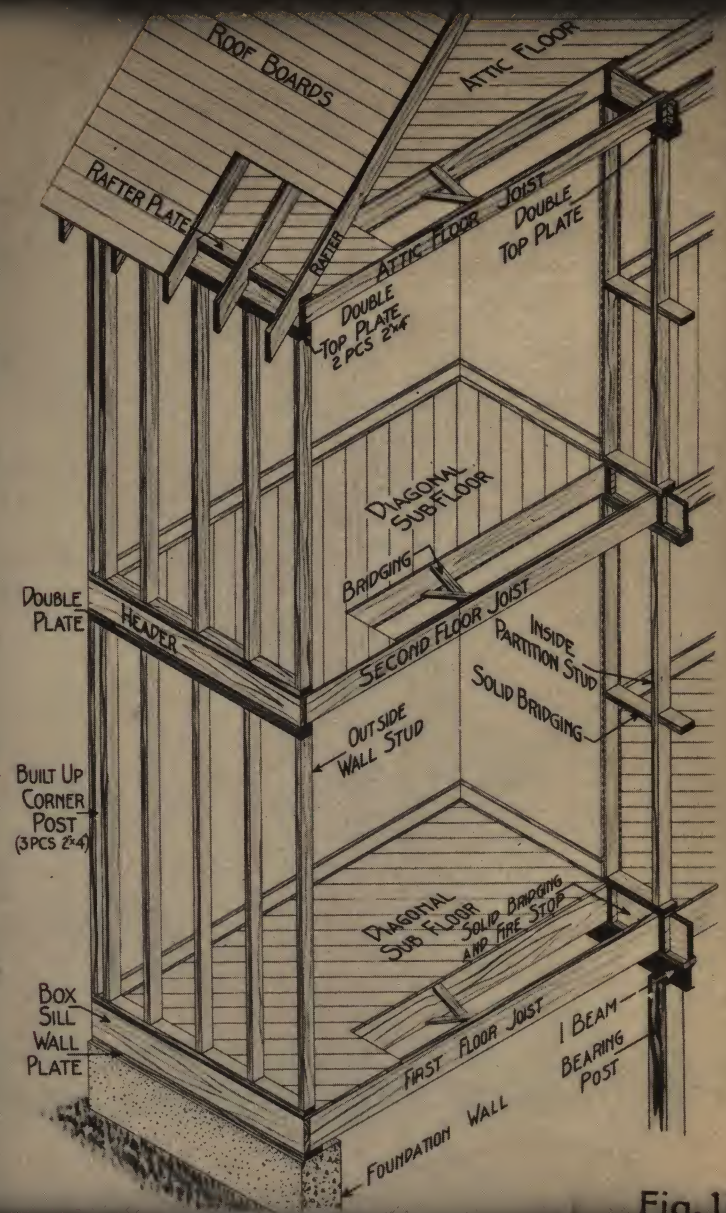


Fig. 12

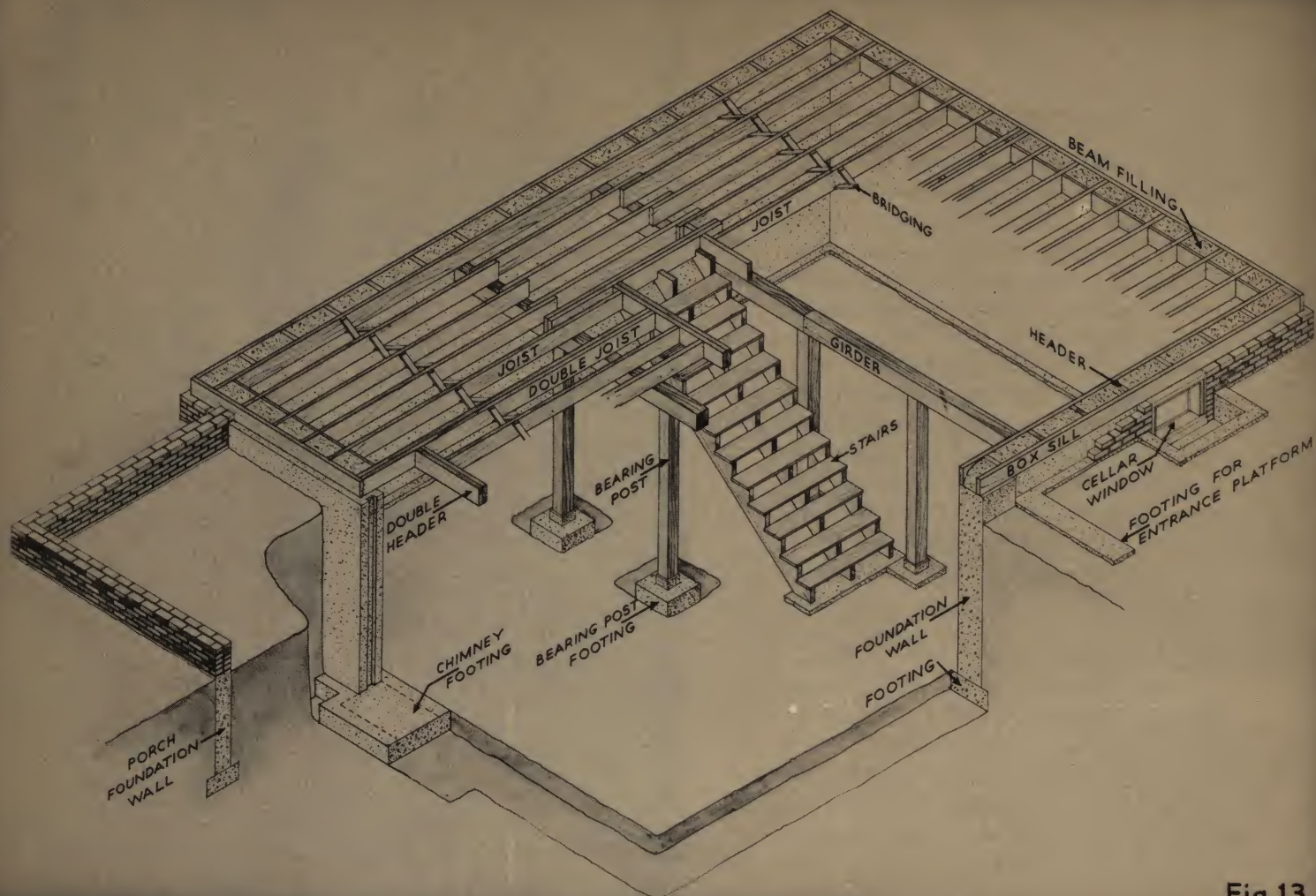


Fig.13

● This illustration shows the first stage in the construction of the house shown on page 10. The foundation and piers have been completed and the carpenter work begun.

In the building of this house, as has been pointed out, the improved Balloon method of framing has been used. The method of procedure is usually as follows:

After excavating for the basement, trenches are dug for all footings and piers. The footings, foundation walls, bearing post footings, chimney footings and porch piers are then put in, in the order mentioned. As the foundation wall is built up, the cellar window frames are set in place. The carpenters then place the gir-

ers and girder posts, after which the box sills are laid out and the floor joists put in place. All openings through the floor for cellar stairs, chimney and clothes chutes, if any, are then framed.

The joists around these openings are doubled, as are the joists under all partitions set parallel to the joists. If beam-filling is used, as in this case, the one-inch boards which hold it in place and the joist headers are now put in and the beam-filling poured.

Bridging (See Figure 15, Page 25) is fitted in between the joists in the middle of the span and nailed to the joists. The rough stair horses for the cellar stairs are then cut and put in place.

SUPPORTING TIMBERS

FEW INDEED are the houses whose supporting timbers are not sufficient to carry even heavier loads than they will ever be called upon to bear.

"Why, then," the prospective builder is quick to ask, "must I interest myself in the supporting timbers in my new home?"

The answer is simple. Many house annoyances are caused by cheapening the house through the use of undersized supporting members.

How to determine the size and spacing of supporting timbers, involving as it does engineering problems, will not be treated at length in this book, especially since every house presents problems which must be treated on their own individual merits. For the owner whose home is designed by a capable architect and built by a conscientious contractor, it is safe to assume that this matter will be taken care of satisfactorily.

The function of the supporting timbers is not merely to prevent the house from tumbling down. Many a house is cheapened by the use of undersized or too few supporting timbers and yet has strength enough to support any ordinary load. But these houses lack stiffness. And stiffness is vital to the satisfactory house.

POSTS AND GIRDERS

THE outer ends of the joists which support the first floor rest directly upon the foundation wall, or on a sill which, in turn, rests upon the foundation wall. The inner ends of these joists rest upon girders which are supported by bearing posts as illustrated in Figure 13.

These girders and bearing posts support the main bearing partitions as well as a part of the weight of the floors and the contents of the house. They should, therefore, be of a size sufficient to support this weight. What has been said above about determining the size and spacing of supporting timbers applies, of course, to the posts and girders.

SILLS

THE sill furnishes a means of securing the superstructure to the foundation and provides a nailing surface for the joists. There are several types of sills in use which have the approval of good builders; three of these are shown in Figures 8, 10 and 12.

If a house is to be firmly anchored to the foundation (and it surely should be for a number of reasons), the sill must be more than merely set on the foundation. The solid or timber sill should be anchored by means of bolts, and the box sill by concrete, known in this use as "beam-filling." This beam-filling also seals the joint between the framework and the foundation. When a solid sill or a combination sill is used, the joint between it and the foundation should be sealed by placing the sill, or the plate, on a bed of mortar.

In the hurry-up kind of construction this anchoring and sealing is often neglected or done in such a haphazard manner as to be of little value. Good workmanship in such places as this costs no more, and you will find it worth while to see that you get it. With good foundations and footings and with the primary supporting members of the house properly taken care of, you have a good start on a substantial house.

JOISTS

THE joists furnish the support for the floors. Joist sizes, like girder sizes, are dependent upon the length of the span they bridge and upon the load they are required to carry. Failure to use joists of sufficient size is sometimes the cause of sagging, squeaking floors that seem insecure under foot, rattling light fixtures and cracked plaster in the ceilings underneath.

Floor joists are often seriously weakened by mechanics when they are installing the plumbing and heating systems. It is highly important that the carpenters, who are familiar with the requirements of these framing members, do whatever cutting and notching of framing members as may be necessary in this connection. It also becomes necessary to cut away joists for stairways, chimneys and other floor openings. This obviously weakens the floor structure and this lost strength must be regained. Just how it is done is illustrated in Figure 16.

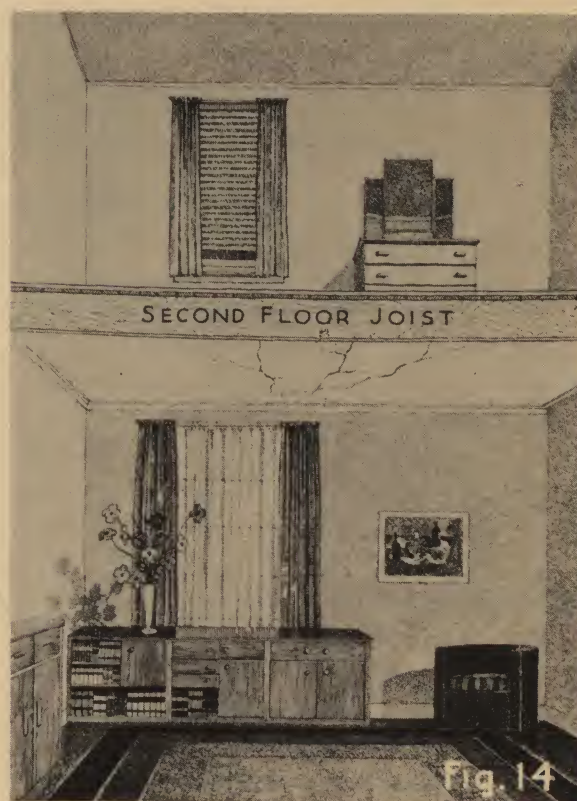
BRIDGING FLOOR JOISTS

BY bridging is meant those small braces that extend crosswise from the top of one joist to the bottom of the next and in a straight, continuous line the length of the house. A trip to your basement will, or should, reveal one or more rows of bridging. It may be difficult to realize the value of these small braces, but their importance can hardly be over-emphasized.

The purpose of bridging is to keep the joists in alignment and to distribute to all of the joists any exceptionally heavy, concentrated loads or sudden jolts that may be applied directly above one or two of them. Tests have shown that it requires three times as much weight to cause a certain amount of deflection in a bridged beam as it does to cause the same deflection in one

that is not bridged. Figure 15 illustrates one good method of doing this bracing. Bridging is just as necessary between the second floor joists, though, of course, it is not visible in the completed house.

It is difficult to remedy defects due to poor bridging, or lack of bridging, once the house is built, but a simple matter to check during construction.



● This illustration shows the result of using floor joists of insufficient depth to have the required stiffness. Hence the sagging and the cracked plaster. Too small joists are often used merely because it is known that they will support the floor. These overworked joists invariably sag, however, when loads are applied, and cracked ceiling plaster and unsatisfactory floors are the result. Sometimes, when sagging floors are not noticeable to the eye, overworked joists are indicated by the feeling of insecurity when the floor is walked on.

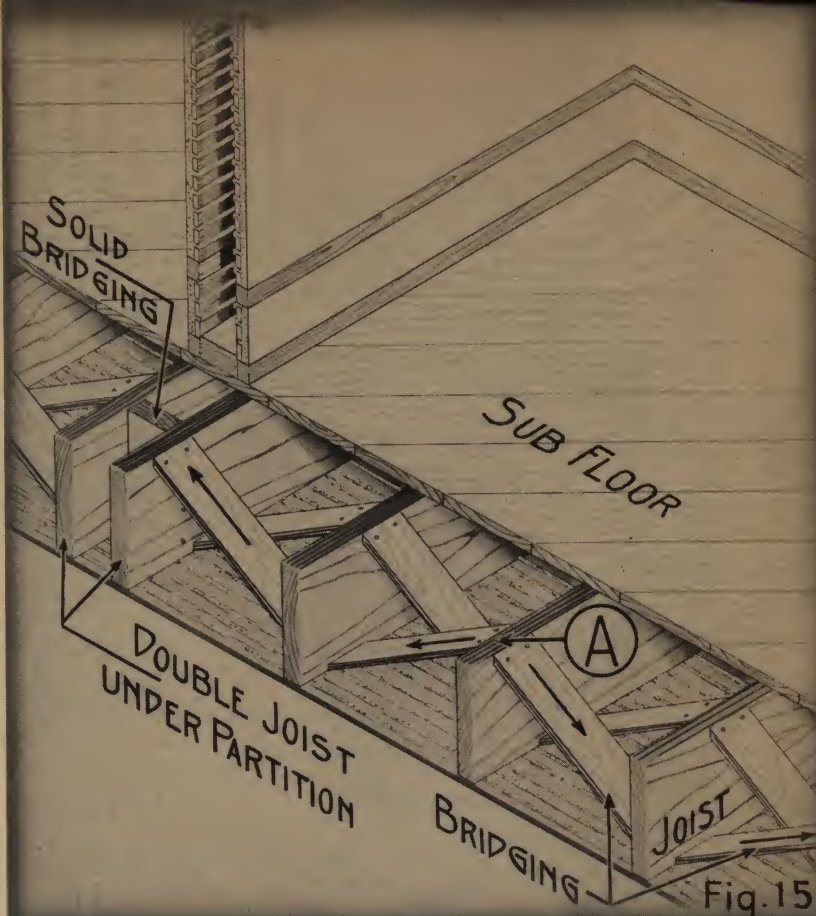
● This picture illustrates the proper bridging of floor joists so essential to good house construction. It is an item overlooked or only superficially taken care of in many houses where correct construction is sacrificed for speed and cheapness.

A load suddenly applied to a properly bridged floor joist is transmitted through the bridging to the neighboring joists and thus absorbed without damage.

Bridging tends to hold all floor joists in equal alignment but to be effective must be properly fitted and securely nailed.

Wherever joist spans exceed eight feet, bridging should be used. Exceptionally long joist spans should be bridged every six feet. Where a bearing partition runs parallel to the joists, the double joists beneath it should be braced with solid bridging.

To get the best foundation upon which to lay the finished floor and to stiffen the framework, the sub-floor boards should be laid diagonally with the joists.



● When it becomes necessary to cut away one or more of the floor joists, as in the case of an opening for a stairway, the strength lost in cutting off these joists must be regained.

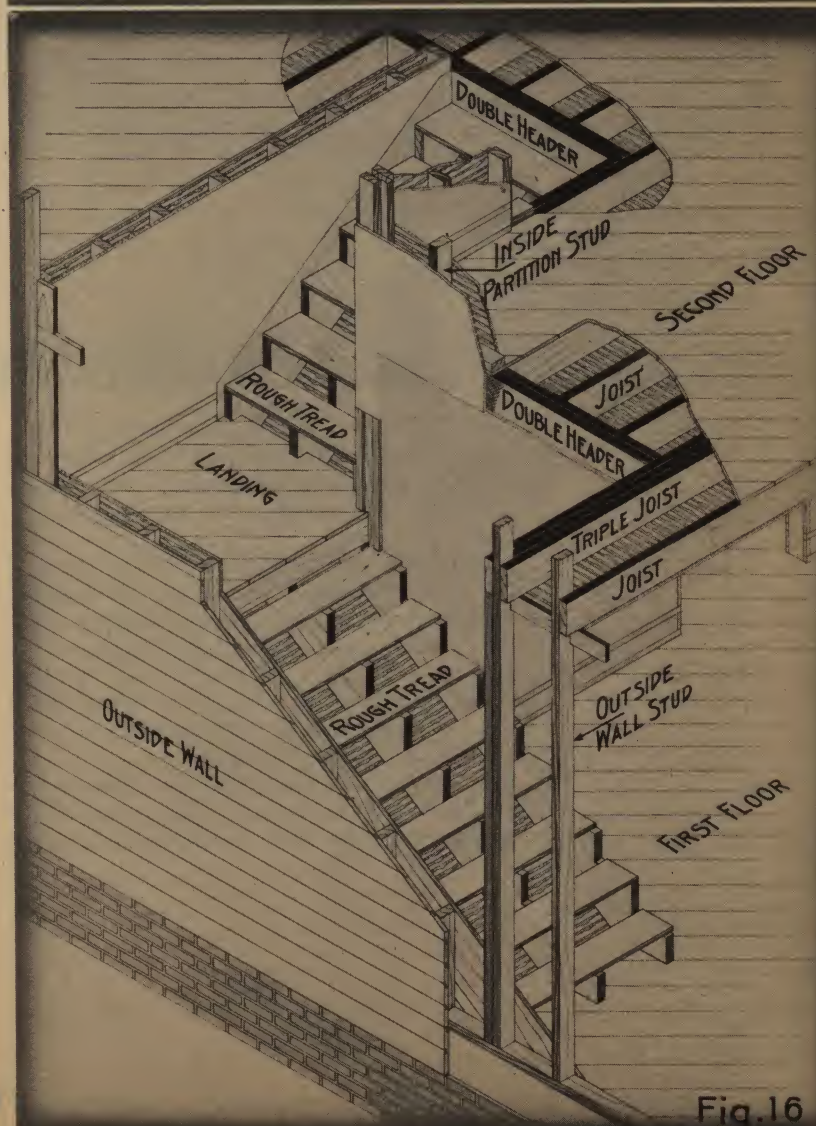
Good practice calls for framing around floor openings similar to that shown here. The loose ends of the joists cut away are secured to a header composed of two pieces of lumber of the same dimensions as the joists.

These headers are, in turn, supported by double or triple joists, depending upon the amount of material it is necessary to add in order to return the strength of the joists that have been cut away. The framework around the opening is thus again tied together and the lost strength is regained.

Where headers longer than six feet are necessary, they should be fastened to their supporting joists by means of stirrup irons or joist hangers.

This illustration brings out very clearly those members which need reinforcing. The amount of added material required has in each case been designated.

Observance of these suggestions will insure construction in and around the stairway that will prove satisfactory in every way.



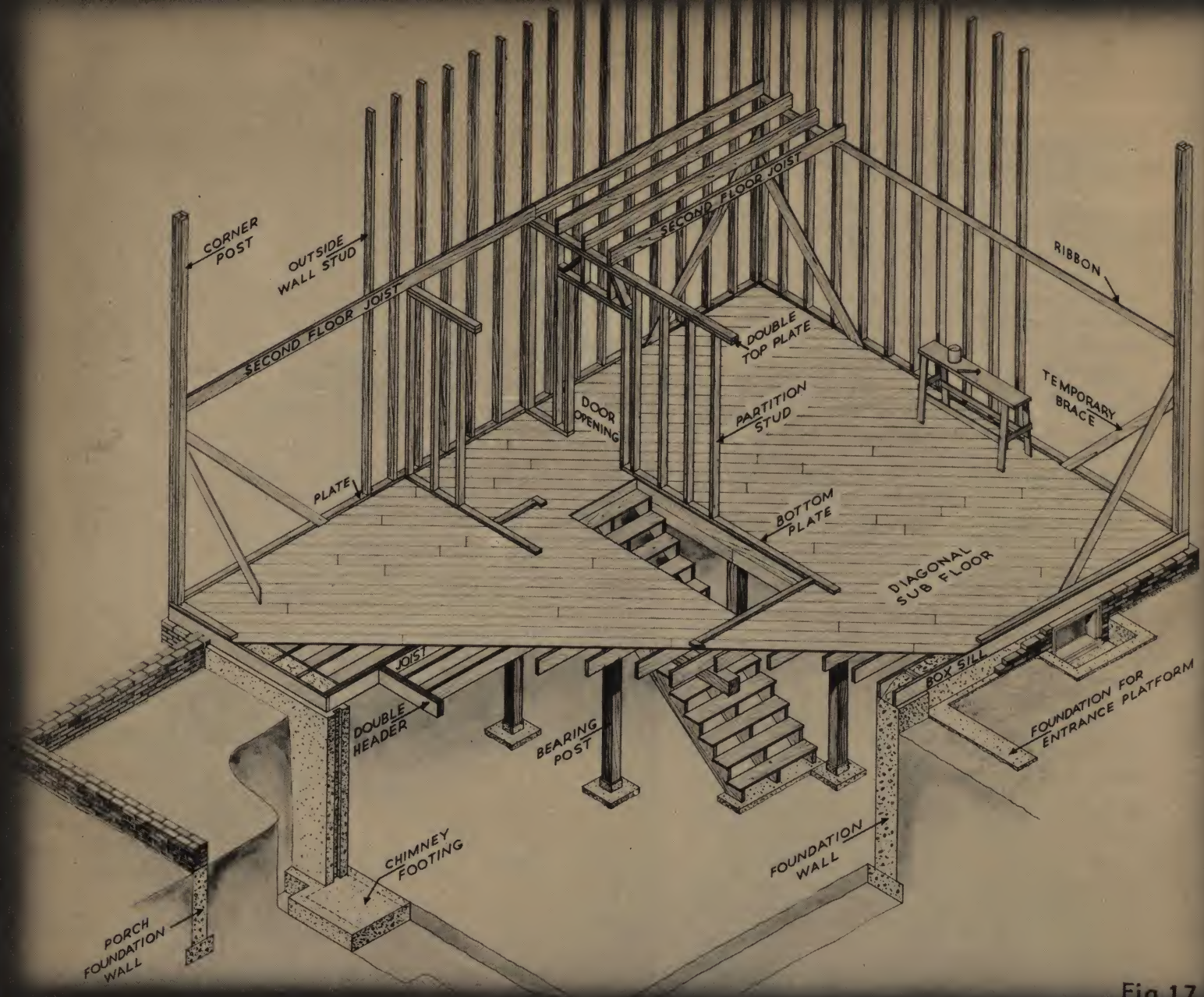


Fig.17

● This illustration shows another stage in the construction of the house shown on page 10. The sub-floor boards are here shown laid diagonally over the first floor joists.

For the sake of simplifying the illustrations in this series of drawings, the inside bearing partitions are shown resting on plates set on top of the sub-floor. In actual practice it would be better to run these bearing partition studs down between the joists and rest them directly upon the girders below, as suggested in Figure 20.

The studs and top plates for the first floor bearing partitions are cut and nailed together and the door openings in these

partitions are framed before they are raised and braced in place.

The top and bottom plates and the ribbon boards for the outside walls are then cut to exact length and the position of the outside wall studs is marked on each; also the position of all window and door openings. The outside wall studs are cut to proper length and notched out to receive the ribbon board. The corner studs are then framed, raised and braced in place. The ribbon board and remaining studs are next put in place.

The floor joists for the second floor are then put up as shown. The next drawing in this series appears on page 37.

FLOORS

DESPITE the fact that precautions are employed to assure proper floor support, attention must also be given to correct methods of laying the sub-floor and finish floor.

SUB-FLOORS

THE sub-floor is the rough under floor which is nailed to the joists and over which the finish floor is laid.

The sub-floor, if laid diagonally over the joists, gives a better foundation for the finish floor, and especially on the upper floors, also adds considerable stiffness to the structure.

The importance of properly nailing the floors can hardly be overstated. Many people are surprised to learn that it is the working up and down of the nails in their sockets that causes the annoying creaking and squeaking of floors when they are walked over. Bulging, humpy floors are also often the result of too few nails or of improper nailing. A nailing schedule for the laying of sub-floors is shown here.

For 4-inch boards—Use 2 nails per board per joist.

For 6-inch boards—Use 2 nails per board per joist.

For 8-inch boards—Use 3 nails per board per joist.

For 10-inch boards—Use 3 nails per board per joist.

For 12-inch boards—Use 3 nails per board per joist.

Since the finish floors are almost the last thing to go into a house, they will be discussed farther on in the book.



● This shows what happens to plastering on an inside wall when partition settles.

In addition to the cracked plaster in the corner, which is going to demand expensive repairing of plaster and premature redecorating, an unsightly crack has developed under the baseboard.

The condition noted in this picture is a result of one or more of the following causes:

1. Faulty footings under bearing posts.
2. Too small girders or too few posts.
3. A wide opening in a wall below this one improperly framed.
4. Joists under partition not doubled.
5. Joists of insufficient size.

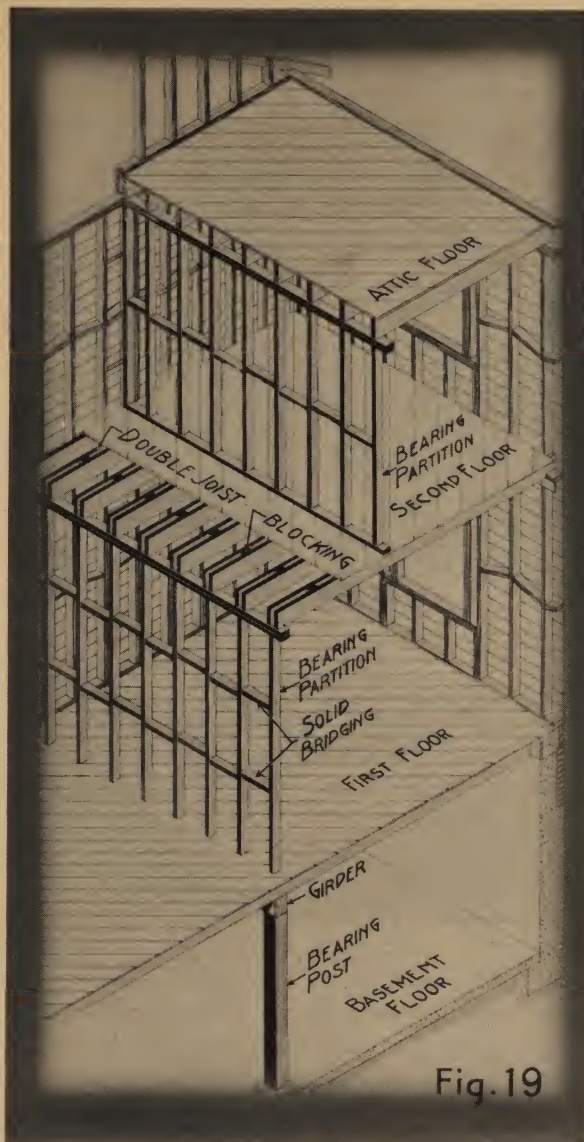


Fig. 19

● Here is shown a condition not uncommon in house construction, i. e., a second floor bearing partition not directly over the bearing partition of the first floor but near the middle of the joist span. This condition calls for additional strength in the second floor joists which, in this case, has been secured by doubling the joists.

Note the blocking between the double joists and also that solid bridging has been added between the supporting studs in the main bearing partition.

This drawing also illustrates the economy in so planning a house as to have all bearing partitions directly over one another and directly above the supporting girders; thus avoiding the necessity for this extra reinforcing.

While the drawing shows a correct method of meeting the situation it illustrates, it is not necessarily the exact practice that should be followed in all cases. As pointed out in the text, it is more economical, where possible, to have bearing partitions on all floors directly over the bearing posts and girders in the basement.

PORCH FLOORS

NO flooring receives harder wear than that on the porch. Attention to the following points will add materially to its life.

1. The porch floor should have a slight pitch so that water will run off quickly. Substantial piers and footings are necessary to assure an even floor year after year.

2. Porch flooring should be dry when laid.

3. The joints of the porch flooring should be given a coat of white lead and oil just before the flooring is laid, and the whole floor, particularly under columns, should be painted immediately after being laid. A fresh coat of paint each year will greatly increase the life of the floor.

4. Circulation of air under the porch should be provided.

BUILDING AGAINST SHRINKAGE

SHRINKAGE is the natural result of the drying of wood. While certain difficulties in many houses are traceable directly to it, it does not follow that these defects need to be a part of the wood house.

Shrinkage may be minimized by the use of seasoned lumber and a few simple construction methods sometimes overlooked by the builder.

Water exists in wood in two conditions: as free water contained within the cell cavities and as water absorbed in the cell walls. Removal of the free water merely reduces the weight of the wood; shrinkage begins with the removal of the absorbed water, and the amount of shrinkage that will take place in a piece of wood is directly proportionate to the amount of moisture which the cell walls have absorbed.

Therefore, since green lumber with a moisture content of 25 to 30 per cent will shrink much more than lumber with a moisture content of only 15 per cent, the wisdom of using seasoned lumber in the framework of a house is immediately apparent.

Shrinkage of wood, however, like the expansion and contraction of steel, cannot be entirely eliminated. Just as steel expands under heat and contracts when cooled, so lumber, unprotected by paint, takes on and gives off moisture according to the variations in the humidity of the surrounding atmosphere. As a house ages, the lumber in its framework, subjected to the dry artificial heat in winter, may, over a period of years, dry to a moisture content as low as 6 or 8 per cent. It is not practical to use framing lumber in the building of a house with as low a moisture content as this since, even though the lumber were dried to this state in

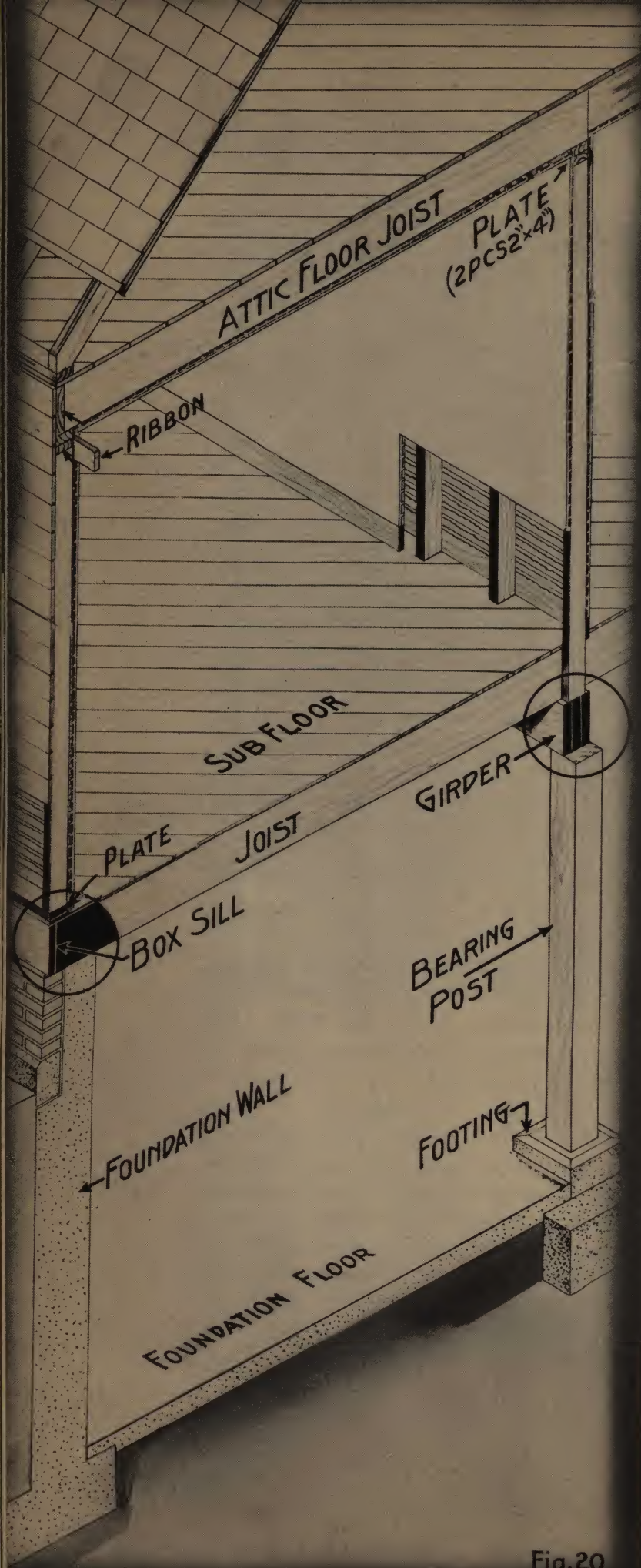
the beginning, it would, during its process of building, absorb enough atmospheric moisture to bring it back to air-dry condition.

This additional shrinkage must, therefore, be taken care of in the manner in which the house is built. And this is rendered easy by the fact that lumber in drying shrinks mostly across the grain (in cross section) and only infinitesimally lengthwise (with the grain), making it necessary in designing the frame of a house merely to minimize and equalize as far as possible the amount of horizontal framing lumber appearing in cross section in the outside walls and bearing partitions.

In the properly designed house frame, then, the horizontal framing members in the outside walls and partitions—which are the only members in which wood in cross section is used, and so the only members subject to shrinkage—are minimized and equalized so far as it is possible without sacrificing the strength and rigidity of the structure. This may sound a bit complicated and involved, but reference to Figures 20 and 21 will clarify the matter.

In these illustrations proper and improper methods of providing for shrinkage in the improved Balloon Frame are shown. The same principle can, however, be applied to other types of frames.

Good builders everywhere are recognizing how easy it is to build against shrinkage and so are avoiding the numerous house ills that might otherwise result from the uneven settling of walls and partitions. Here again we have an illustration of how simple it is to see that one's house is substantially built if one will take the trouble to study the working plans and then check up the various details as the house is being built.



RIGHT

● This illustration shows one method of building against shrinkage by equalizing and minimizing, as far as possible, in both the outside walls and inside bearing partitions, the amount of lumber the shrinkage of which would cause settlement.

The members which are involved in this consideration appear in solid black within the circles.

In the outside wall any settlement which might occur due to shrinkage in the box sill and plate would be offset by an approximately equal amount of shrinkage in the girder under the inside bearing partition.

The slight additional settlement which might occur, due to shrinkage in the plates, upon which the second floor joists rest, would be so slight as to be negligible.

In contrast to Figure 21, note that the first floor bearing partition studs are brought down between the joists to rest directly upon the girder. Note also that the second floor bearing partition studs rest directly upon the top plates of the first floor partition.

Figure 21, in contrast to this one, shows a form of construction in which the shrinkage problem is ignored.

Any shrinkage that might occur in the top plates just beneath the attic floor joists, in both this drawing and Figure 21, would affect the attic floor only and would not be serious, due to the fact that the thickness of these plates is exactly the same in both the inside and outside walls. Any settlement of the attic floor would be so slight as to be negligible and would also be uniform.

Fig.20

WRONG

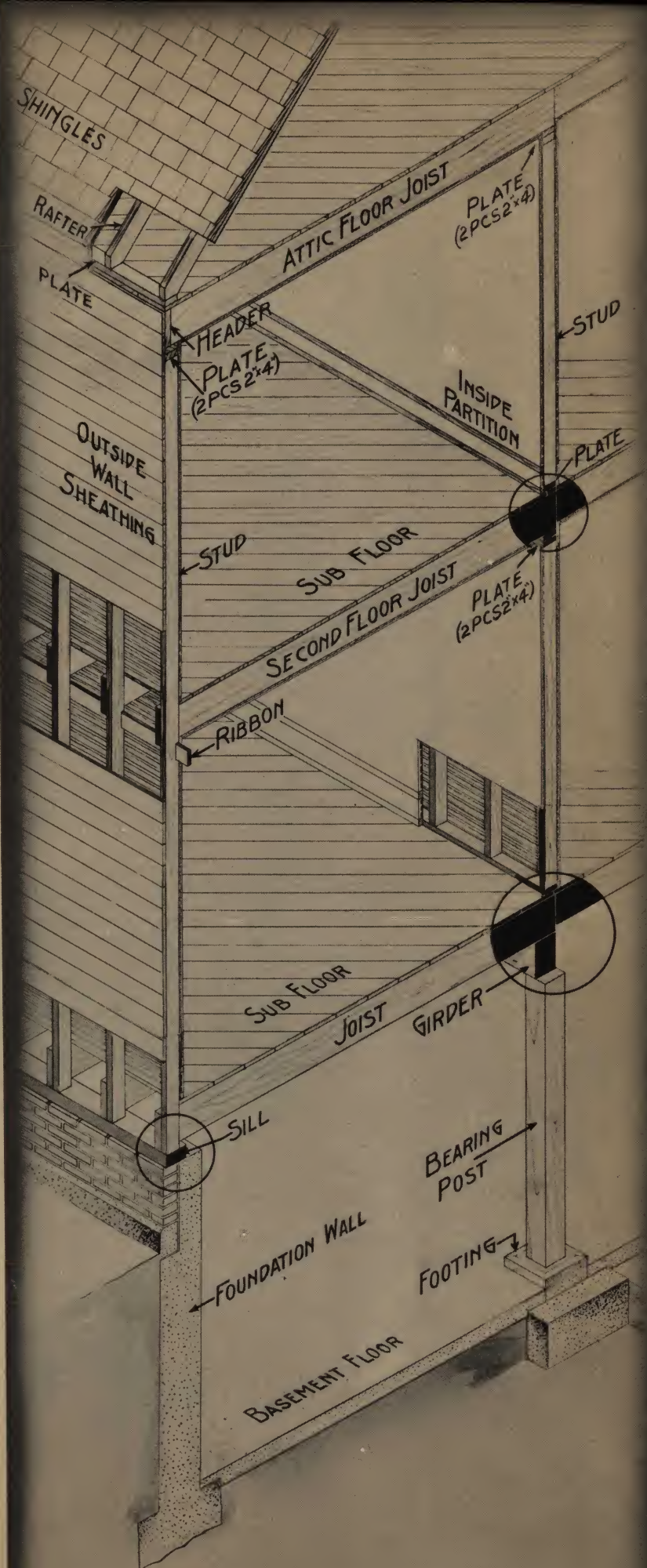
● This illustration of a common method of framing shows the shrinkage problem unsolved. The solid black within the circles indicates the relative amounts of lumber, the shrinkage of which would cause settlement in the outside and inside walls.

In the outside wall, settlement due to shrinkage in the $3\frac{1}{2}$ -inch sill would be so slight as to be negligible—not over .08 of an inch if the sill were air-dry.

In the inside bearing partition, however, note that both the first and second story partition studs rest upon plates that are set on top of the joists and sub-floors. Any shrinkage in the cross section dimensions of the girders, first and second floor joists, sub-floor boards and plates will, therefore, cause settlement in this inside wall.

To solve correctly this problem of shrinkage, the house frame should be so constructed as to minimize and equalize, as far as possible, the amount of lumber appearing in cross section within the bearing walls and partitions.

Note in Figure 20 how easy it is through a slight variation in manner of construction to eliminate uneven settlement of this character.



WALL AND PARTITION FRAMING

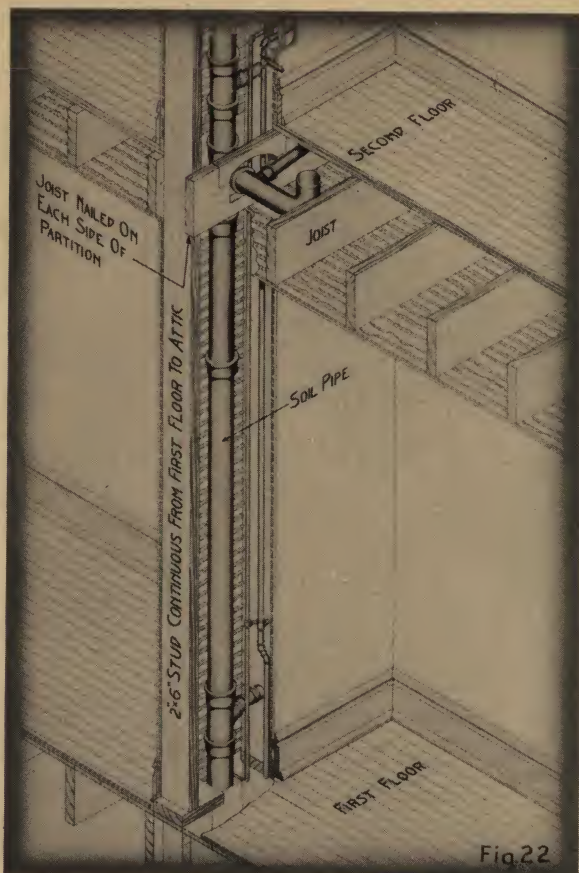


Fig.22

● Lack of proper framing of the bathroom floor joists and the partitions in which the plumbing and heating pipes are to be located and careless cutting and notching of frame members, to permit the passage of pipes, are responsible for many unsatisfactory bathroom floors and walls.

The above illustration shows one method of building a strong partition for carrying these pipes and one which is not weakened by the necessary cutting and notching.

In this case, the 2x6-inch partition studs are made continuous from first floor to attic. This allows ample room for all pipes and makes a partition which loses no strength in the installation of plumbing and heating systems.

The joists at each side of the partition are nailed to each stud, thus assuring ample support for the floor. The joist notched out for the pipe should be cut in the manner shown and the piece replaced to provide nailing surface for the floor.

OBVIOUSLY, the first essentials of wall framing are strength and rigidity, since the walls are required not only to carry a large part of the weight of the house, but must, as well, resist pressure from occasional high winds.

Wall and partition framing consists of studs, usually 2x4's, top and bottom plates and the necessary bracing and fire-stopping. Careful cutting, fitting, nailing, bracing, and fire-stopping are all essential to sound, substantial walls and partitions.

There are two kinds of walls and partitions, bearing and non-bearing. A bearing partition or wall is one which runs at right angles to and supports the ends of the joists. In other words, a bearing wall or partition is one which bears or supports a load from above. A non-bearing wall or partition acts only as a screen or enclosure.

As has been pointed out, non-bearing partitions should be supported by double bridged joists (see Figure 15). The studs which support the framing around stairways should also be doubled, as shown in Figure 16. Bearing partitions require special support, as pointed out in Figure 19, when these partitions do not occur directly over the partition below. In such a case, the studs in the bearing partition below, which support this off side bearing partition, should be reinforced with two rows of bridging. (This is also shown in Figure 19.)

When a partition supports more than the weight of the roof and two floors, as in the case of a bearing partition in the basement of a two-story house, the studs in this bearing partition which, in such a case, replace the main bearing posts, should be not less than 2x6 or 3x4 inches.

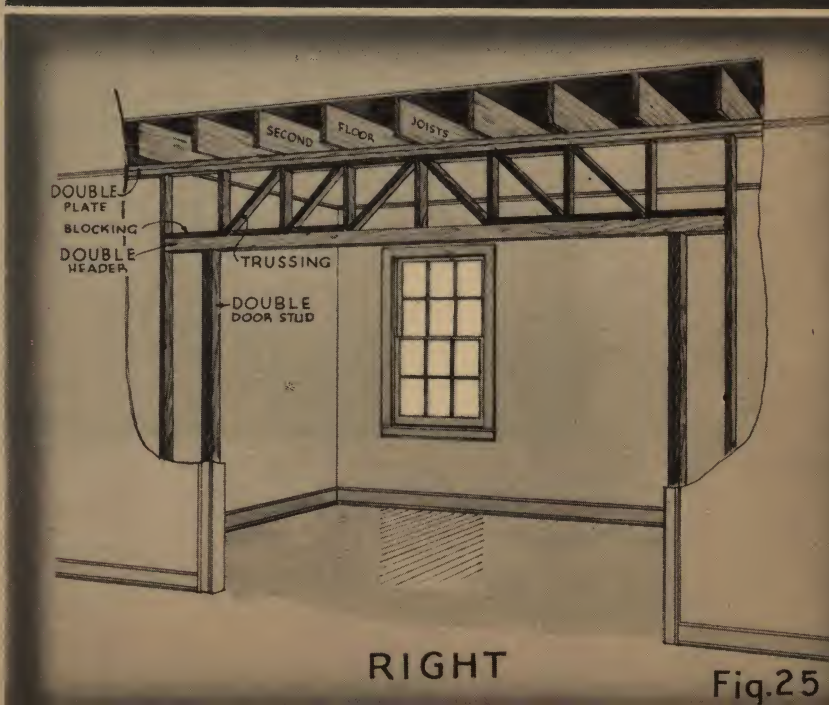
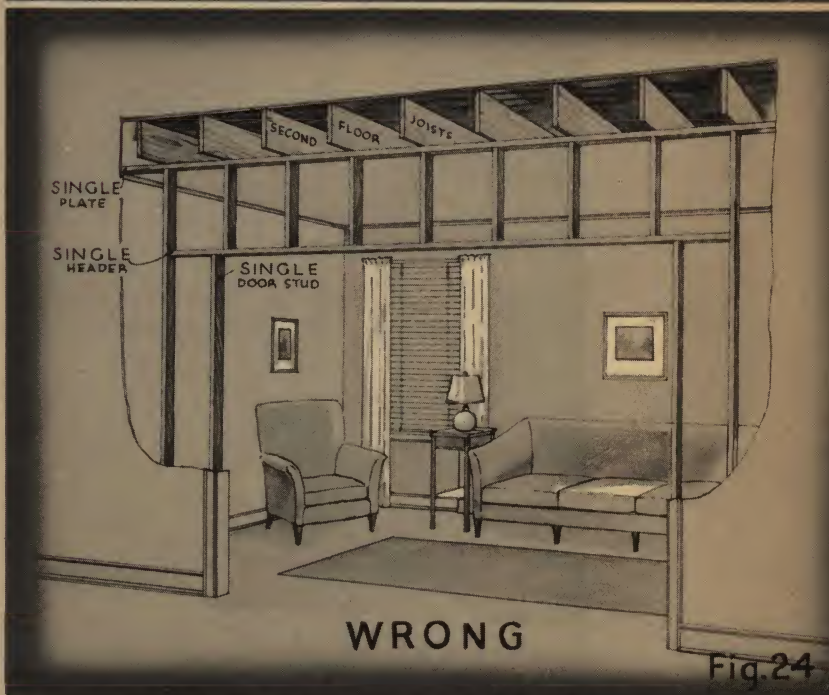
Continued on page 34.

● Here is a condition common in many short-life houses. Figure 23 shows the result of improper framing around large openings in bearing partitions. In addition to the large jagged cracks running up from the opening, note the disfiguring crevice at the ceiling line. Also note that the trim or woodwork over the opening has sagged considerably.

The center illustration, Figure 24, shows the same cased opening with part of the plaster removed to show the cause of the condition pictured above. The framing around this opening is insufficient. The single plate and the single header were unable to carry the overhead load without giving somewhat. Hence the sagging noted in these members.

Figure 25 at the bottom illustrates how, with a little additional time and materials, the condition noted in the first illustration could have been avoided and with it the expense and annoyance involved in replastering and redecorating. Nor does this replastering and redecorating over this opening cure or cover up all of the evils occasioned by this faulty framing. The floor and the partition directly above will have sagged and the plaster on both sides of the partition will have cracked.

Note in the bottom illustration that the headers have been doubled and set on edge. The plate has been doubled also, as have the door studs. The 2x4-inch truss members and blocking have been added to give additional strength and rigidity to the framing. While other methods of meeting this situation might have been designed, the one here shown will illustrate how easily the condition shown in Figure 23 may be avoided.



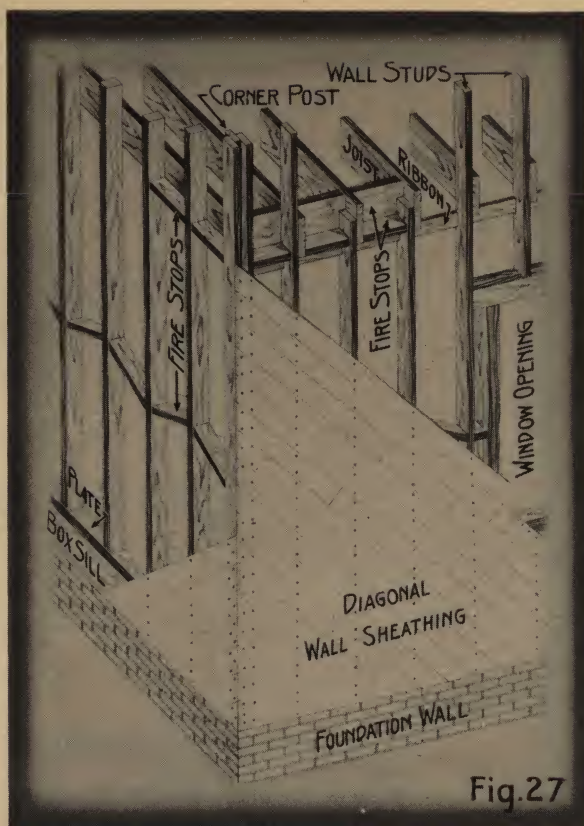


Fig.27

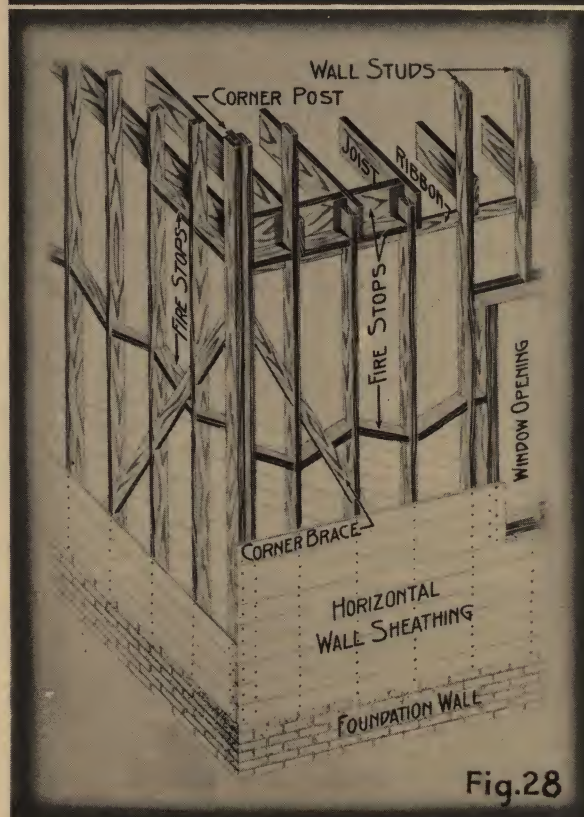


Fig.28

In all cases bearing partitions should have double top plates and should be braced with solid bridging not less than two inches in thickness and not less than the full width of the studs. (See Figure 19.)

The partitions in which the main soil pipe is placed require special framing as shown in Figure 22.



WINDOW AND DOOR OPENINGS

IT becomes necessary in the construction of the house to cut away part of the framing in the outside walls for door and window openings, and in the inside walls, or partitions, for door openings. Naturally this weakens the framework as a whole and the lost strength must be regained by reinforcing the framework around these openings.

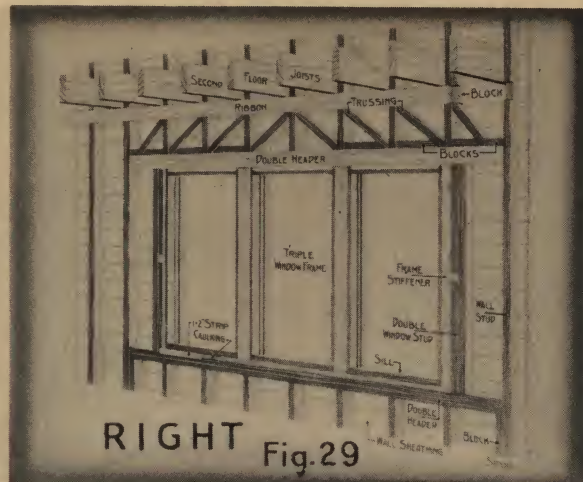
Proper framing over inside openings is illustrated in Figure 25, while framing of outside wall openings is shown in Figures 29 and 30.

- At the left are shown two methods of applying the outside wall sheathing. Diagonal sheathing shown in Figure 27 adds materially to the stiffness and strength of the house.

The use of Endless lumber eliminates the usual added waste, because it is not necessary to make joints on studs.

With the sheathing laid horizontally, Figure 28, corner bracing should be used to give additional stiffness to the structure. The sheathing should be tongued and grooved or otherwise matched and the boards tightly driven together and nailed to each stud with at least two 8-penny nails in each board.

This illustration shows the correct method of framing around a large opening in an outside wall—in this case for a triple window. The construction is very similar to that in Figure 25, for the same principles are involved. Note the adequate trussing and blocking, the double-header above and below and at the sides of the opening, also the frame stiffener and caulking, more clearly shown and explained below.



RIGHT Fig. 29

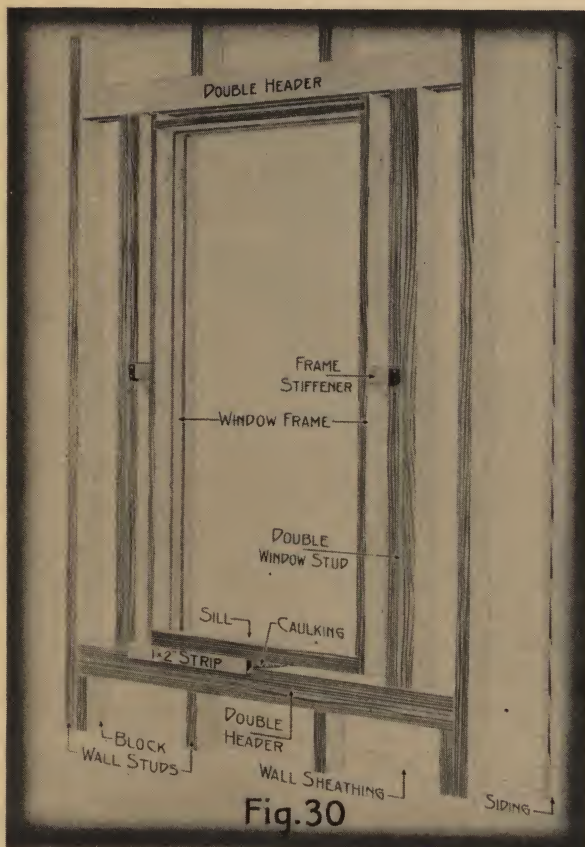


Fig. 30

RIGHT

These illustrations show proper and improper framing around window openings. In Figure 31, single framing members have been used. They do not replace the strength lost in cutting away the studs to make the opening. Figure 30 shows how the framing should be done.

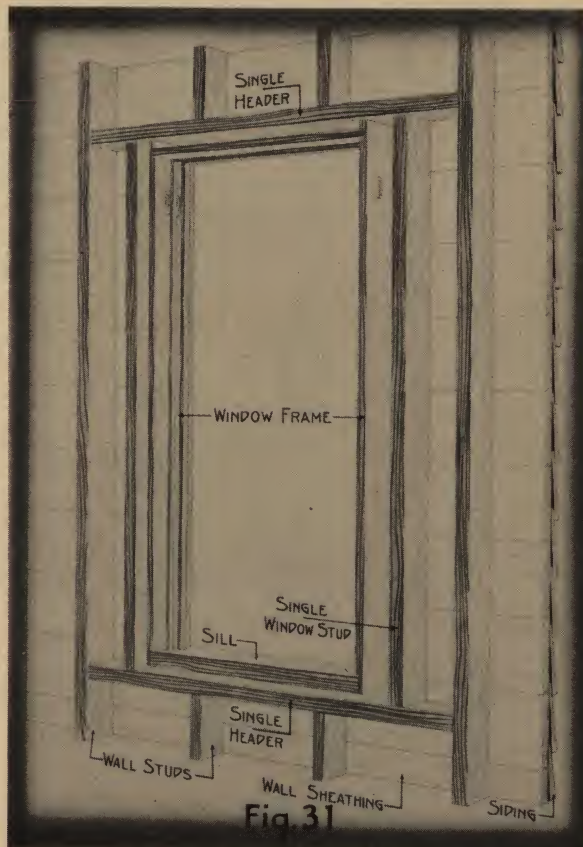
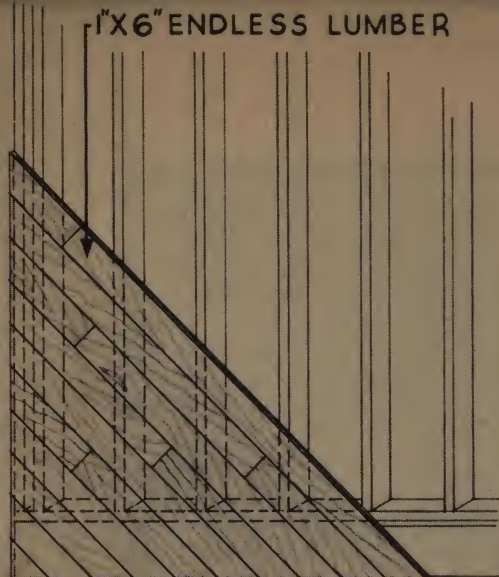


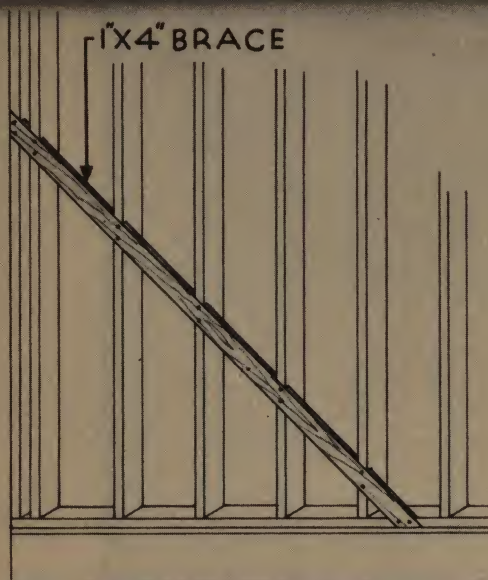
Fig. 31

WRONG

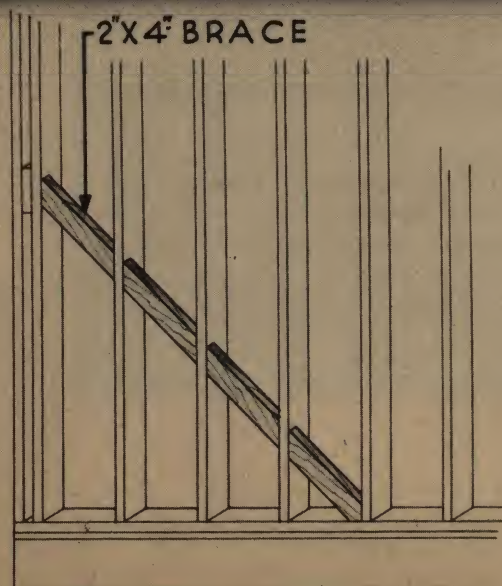
In Figure 31 no caulking is shown. Failure to caulk allows free passage of air into the house. Note the frame stiffeners. These help to keep the window frame straight and eliminate one cause of binding windows.



DIAGONAL SHEATHING Fig. 32



LET-IN BRACING Fig. 33



CUT-IN BRACING Fig. 34

● One of the three methods of bracing shown on this page should be used on all well constructed houses.

● In Figure 32 bracing of the frame is accomplished by placing the sheathing at a 45° angle. Tests prove this method of bracing increases the rigidity of the house from two to seven times, depending on the number of openings which must be left for doors and window frames. This illustration shows the use of end-matched sheathing which may be used without making the joints on the studs. When ordinary sheathing is used, joints should be made only at the studs.

● Some good builders prefer to brace the house frame with let-in bracing shown in Figure 33. This is accomplished by notching the studs to receive a continuous piece of 1x4 which is securely nailed to each stud. This type of bracing must be installed prior to the placing of the sheathing.

● Another popular method of bracing the house frame and the one used in the house illustrated is the cut-in type. This consists of 2x4 members carefully cut and fitted between the studs after the sheathing has been nailed in place, Figure 34.

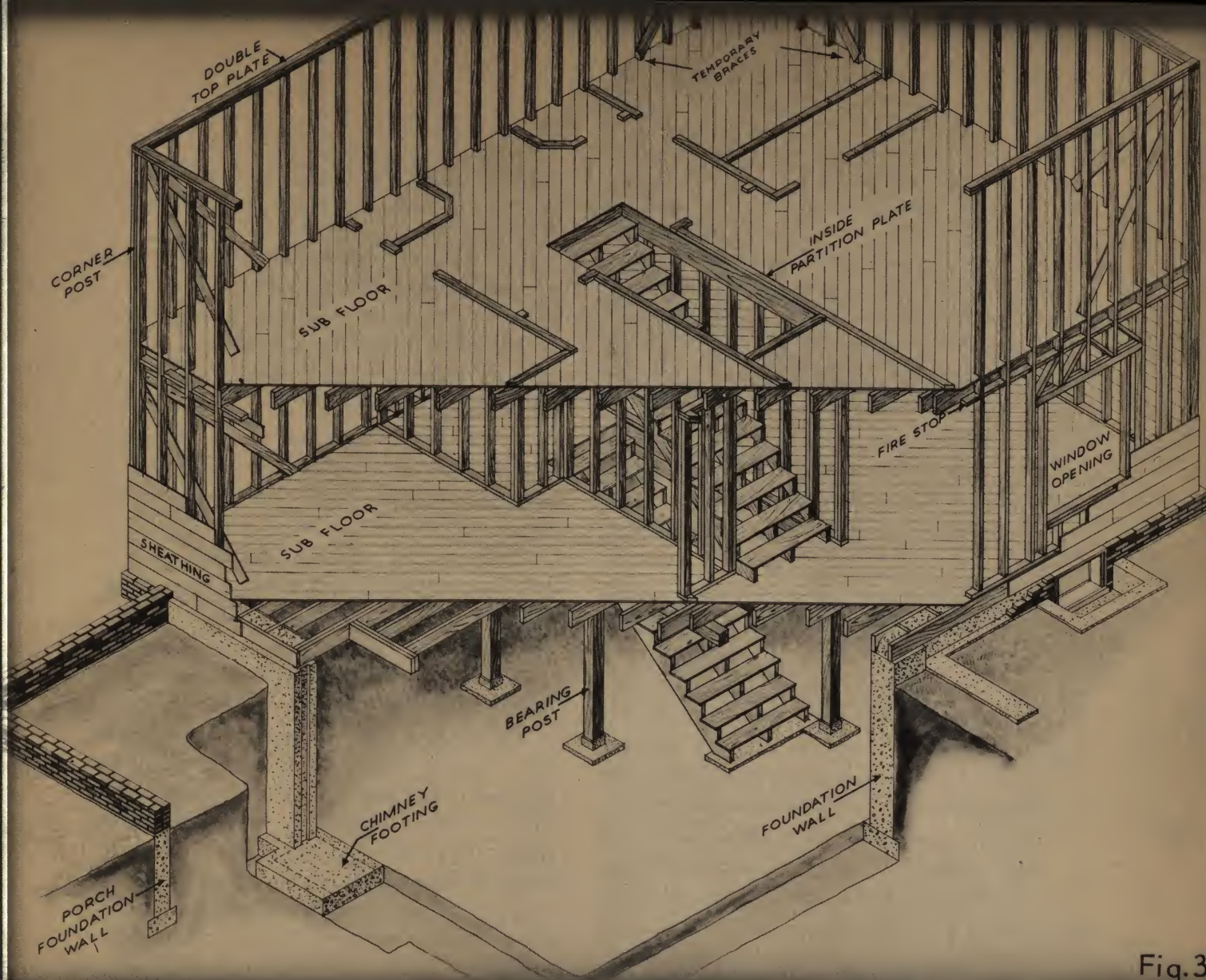


Fig. 35

● This figure shows further development in the construction of the house pictured on pages 10, 22 and 26.

As the second floor joists are laid after the manner described in Figure 17, all openings in the floor for chimney, stairs, etc., are framed as in Figure 16. Joists are also doubled under any partitions that are to run parallel to them.

The outside wall studs are then capped with double top plates and another set of temporary braces put in as shown.

All necessary cutting, doubling and trussing, in the outside wall for the first floor window and outside doors and the fire-stopping at the second floor line is then done, after which the wall sheathing is put on up to the second floor line. The outside

walls are straightened and the bridging is then put in between the second floor joists as in Figure 15. Headers between the joists are also put in.

To simplify this drawing, the cut-in bracing is not shown. Cut-in bracing will be installed after the sheathing has been applied. One of the three methods of bracing shown on the following page should be used in every well constructed house.

The second story sub-floor is then laid diagonally as in the case of the first floor, but running in the opposite direction.

The second floor inside partitions are built in the same manner as those on the first floor.

The next drawing in this series appears on page 49.

FIRE SAFETY IN HOUSES

IT should be realized that no building, regardless of the materials of which it is built, is fireproof so long as its contents are inflammable. The masonry walls of a so-called "fireproof" structure confine the heat of the fire, creating a veritable furnace in which concrete disintegrates and even the supporting steel beams and columns twist and fail and fall into a heap of ruins.

Therefore, since all buildings of whatever nature are subject to destruction by fire as long as their contents are inflammable, the important considerations for the house builder are merely these:

1. How can fires be prevented?
2. In the event of a fire starting, how can it be confined through the manner of construction in a building so as to make its spread difficult and so as to allow ample time in which to get to it and extinguish it?

Only when it is realized that 96 per cent of all dwelling house fires originate *inside* the house and that practically every dwelling house fire is due to carelessness or defects in the internal construction of houses will the importance of these two considerations be fully appreciated.

The installation of electric wiring and fixtures by experienced electricians under competent supervision and according to Underwriters' standards, leaves little chance for fires from this source. Neither is it difficult to so construct the chimney and the framing around it so as to eliminate the chimney as a cause of fire.

There are three methods of fire-stopping:

1. Two-inch lumber fitted in between the studs and joists.

2. The vital points boxed in with one-inch boards and the boxes filled with incombustible material such as loose mortar concrete, mineral wool, etc.

3. Metal lath, bent and nailed into place between the studs and joists. The lath is then plastered and the box thus formed filled with incombustible material.

Fire-stops are put into a building to prevent the passage of flames, hot air and gases. All joints should be tight; otherwise, hot gases will pass through them and ignite the wood above. Poorly fitted fire-stops are little better than none.

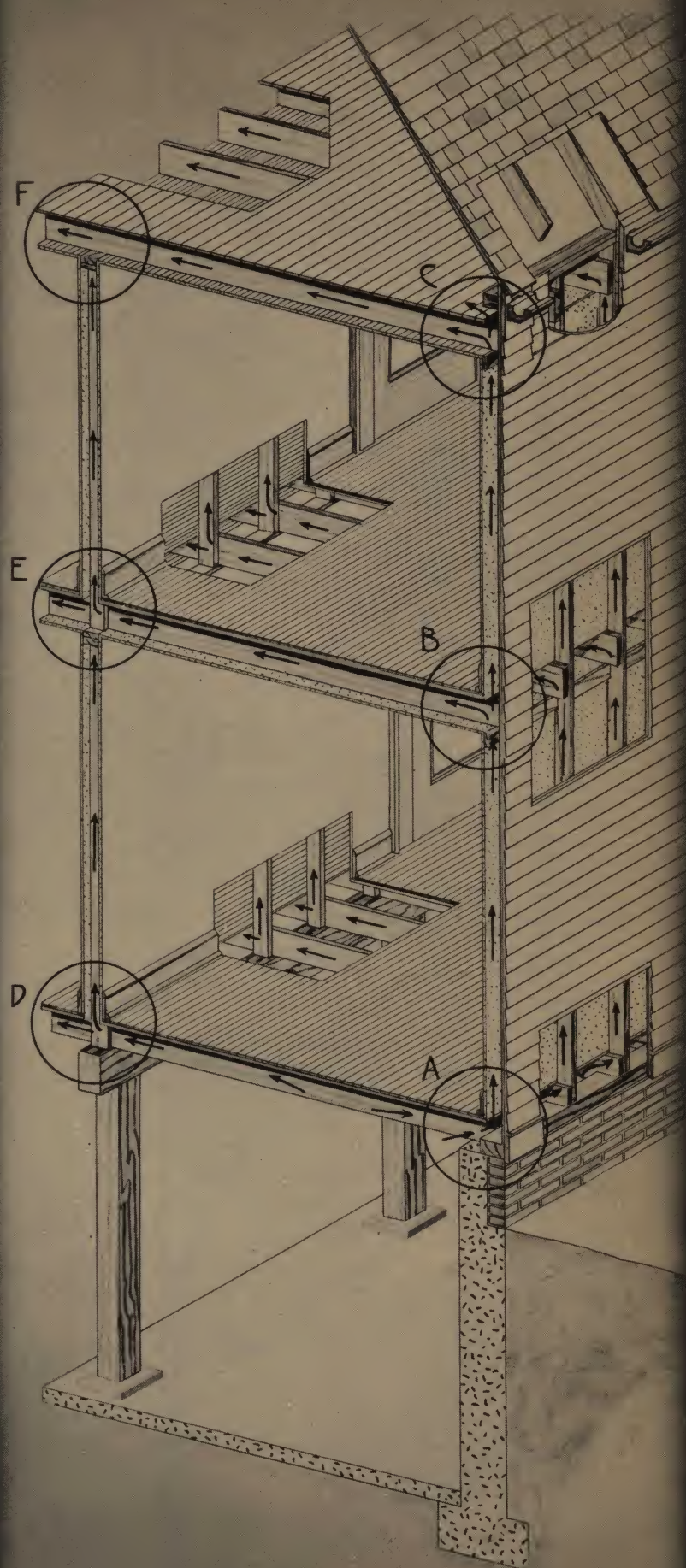
The slight additional expense involved in fire-stopping a house cannot rightfully be charged to fire prevention alone, since much of it serves as bracing in the frame of the house. Fire-stopping more than pays for itself in the additional strength and rigidity it gives to the entire structure. Figure 37 shows how this fire-stopping should be installed.

Thus, it is seen that next to the elimination of the causes of fires, right construction is of first importance in increasing the fire safety in houses—nor can any house, regardless of its outside wall and roof covering, be considered a reasonable fire risk, unless fire-stopping is made an integral part of its internal construction. On the other hand, by proper appreciation of the points brought out in this chapter, it is possible today to build an all-wood house that will be in every way fire-safe.

● One glance at the accompanying illustration, showing a house without fire-stopping, should be sufficient to bring out the importance of closer attention to this important detail in the construction of a house. There are no fire-stops in this house. The arrows indicate the free circulation of air between the floor joists and between the wall studs.

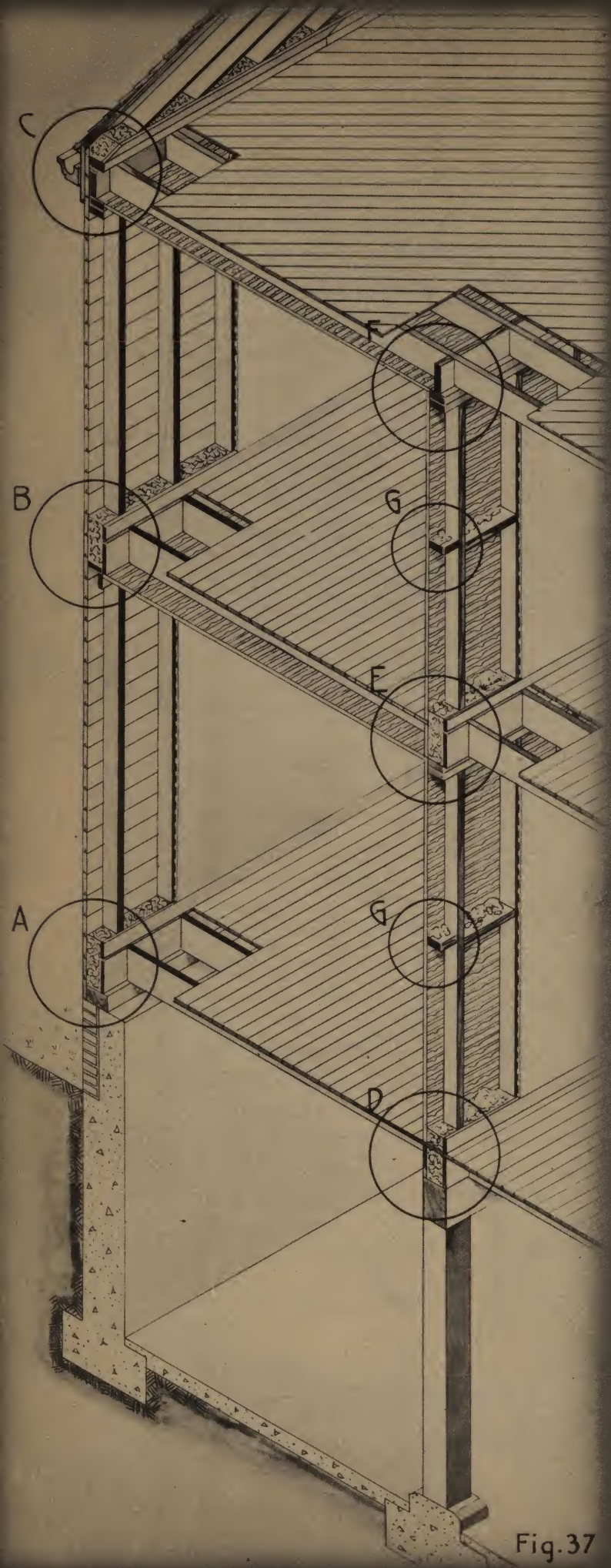
Properly constructed and tightly-fitted fire-stops in the walls and floors, however, would confine the fire to one or two compartments and afford ample time to reach it and extinguish it without serious loss or damage.

The circles "A," "B," "C," "D," "E," and "F" indicate the vital points at which fire-stopping should have been used.



WRONG

Fig. 36



● This shows a method of fire-stopping in which boxes of one-inch boards filled with incombustible material have been used throughout except at point "F," at which point a two-inch plank serves more effectively. Metal lath baskets carefully plastered after they are put in may be used in place of the inch boards.

It is important that when incombustible material is used, the space be filled to a point at least four inches above the floor level, to allow for settlement in the loose material.

A solid sill, although not recommended for the improved Balloon Frame, has been shown at point "A" to illustrate how fire-stopping should be done when this type of sill is used.

This drawing illustrates, in a very general way, the principles of fire-stopping. It does not show all of the different parts of house, however, where fire-stops should be used. In the fire-safe house you will find fire-stops placed not only in the walls and beneath the floors, but in the stairways, around the clothes chutes and sliding door pockets. A number of other satisfactory methods of fire-stopping are also employed.

The slight additional cost of completely fire-stopping a house is more than offset by the added security it gives in return.

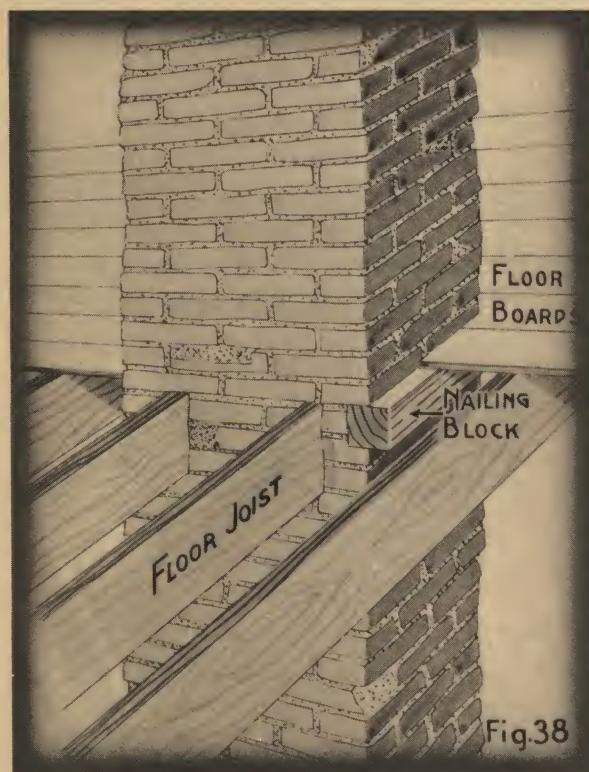
Fig. 37

THE CHIMNEY

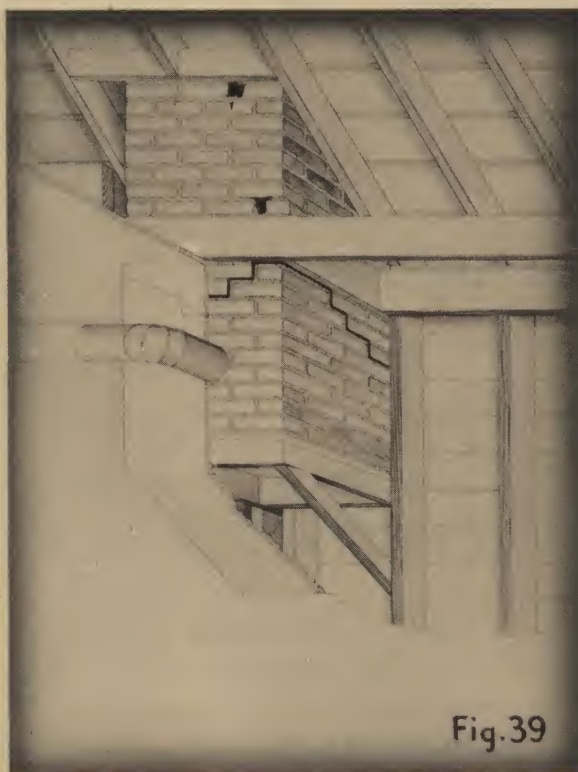
THE chimney should be self-supporting and so constructed as to be absolutely independent of the house framing. Soil conditions govern the size of the chimney footings, but they should never be less than 12 inches deep and should always extend at least 6 inches beyond each face of the chimney.

The walls of a chimney with terra cotta flue lining should be not less than 4 inches thick if built of brick, nor less than 8 inches thick if built of stone.

All combustible materials such as wooden framing members should be at least two inches from the chimney wall. The open spaces between the floor framework and the



● **Wrong.** This construction invites fire and yet, in varying degrees, is not rare but quite common. Note that floor joists, boards and nailing blocks are built into the brickwork of the chimney. In addition to the fire hazard, this construction will result in cracked plaster. The settlement of the chimney will also cause the members framed into it to settle. The correct method of framing around chimneys is illustrated in Figures 40 and 41.



● **Wrong.** A chimney set on a bracket attached to a wall is a fire menace found in many houses even today. Note how the sagging of the bracket has opened the joints in the brickwork. In addition to this, the rafters and floor joists have been framed tight against the chimney, which has only a 4-inch wall without flue lining. A proper foundation for a chimney is shown in Figure 41.

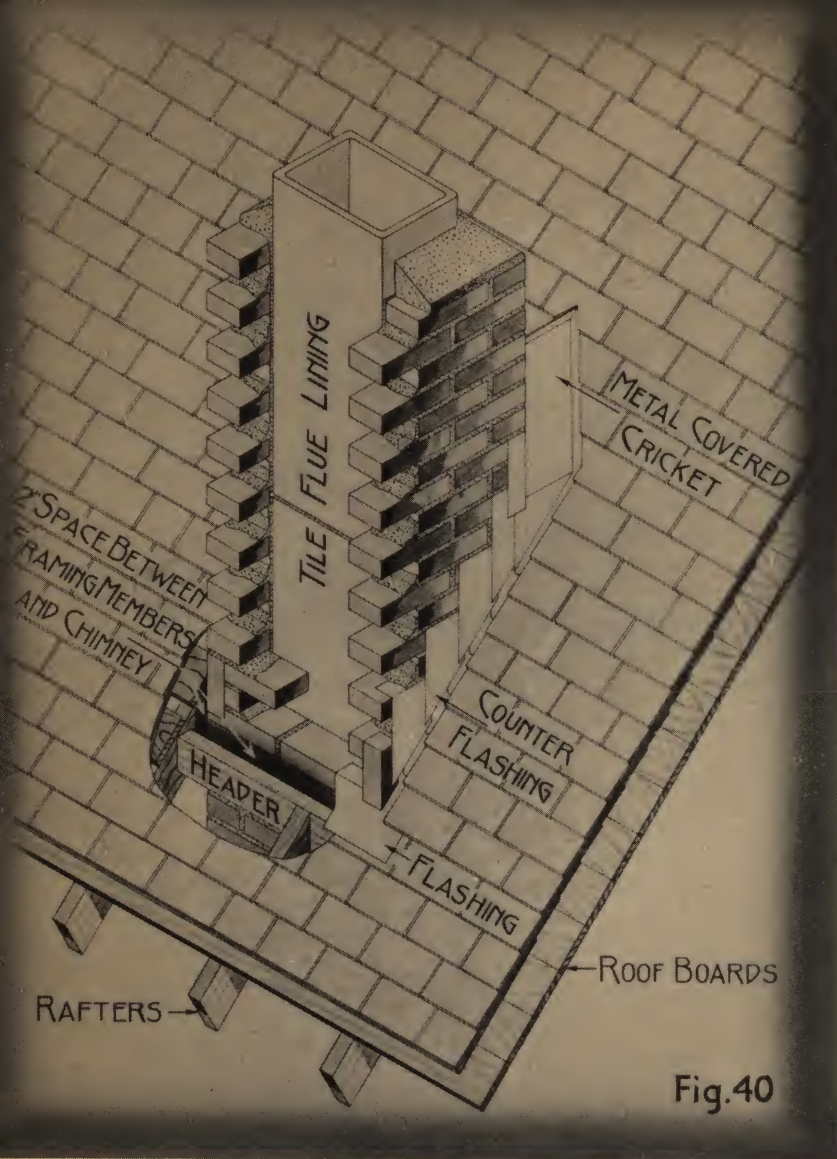


Fig.40

chimney should be filled with mortar, mineral wool, or other incombustible material. Proper framing around the chimney is illustrated in Figures 40 and 41.

While it is permissible, from the standpoint of fire hazard, to plaster directly on the brickwork of the chimney, the practice should be discouraged because plaster cracks are certain to develop. When plaster is applied in this manner, however, the furring strips placed around the chimney to support the base or other interior trim should be insulated from the masonry by asbestos paper at least $\frac{1}{8}$ -inch thick. A better practice is

● Having read that all combustible material should be at least two inches away from the chimney wall unless the brickwork is eight inches in thickness — the reader naturally wonders how it is possible to make a tight joint around the chimney at the roof.

This is accomplished by the use of what is called "flashing" and "counter flashing."

The term "flashing" is applied to the pieces of metal—tin, copper or lead—that are nailed onto the roof along with the shingles and bent up against the chimney wall, while "counter flashing" means the pieces of metal set into the brickwork and bent down over the flashing to form a water-tight joint.

Copper is the best metal to use. It costs but little more than tin or sheet metal and will be permanent, whereas the latter will rust out. It is difficult to replace flashing after it has failed.

The flashings should be arranged to overlap generously and allow for any movement that may occur in the chimney or roof.

What is called a "metal covered cricket" is used to shed the water from behind the chimney.

This illustration also shows what is meant by tile or terra cotta flue lining and how the chimney is made weatherproof with a cement cap. The mortar joints of the flue lining should be well made and struck smooth on the inside.

to box in the chimney with studs, set two inches away from the brickwork, and on these to apply the lath and plaster.

The chimney should be capped with stone, terra cotta, concrete or cast iron and should extend at least three feet above a flat roof or two feet above a ridge roof. This assures a good draft for the heating plant.

Any increase in the wall thickness of the chimney should be made at least 12 inches below the rafters and not be made above the roof except for capping.

The proper construction of fireplaces is fully described and illustrated on page 43.

● This illustration shows a properly-built fireplace and chimney. The chimney has two flues, one for the fireplace and one for the furnace. Note that the chimney stands practically independent of the framing around it. The following points are essential to the construction of a successful fireplace and chimney:

First—a good footing. This should have a projection of at least six inches and a depth of 12 inches. Do not use the foundation wall as one of the walls of the ash pit.

Second—the width, height and depth of the fireplace opening should be of proper proportion to each other and to the size of the room.

A fireplace opening about three feet wide and two feet high is large enough for the average living room. The depth should never be less than 16 inches, nor more than 24 inches. The height, except for very large fireplaces, should not be over two feet six inches and should never exceed the width. The area of the cross-section of the smoke flue should never be less than one-tenth to one-ninth the area of the fireplace opening.

Third—it should reflect heat into the room. This is accomplished by making the back two-thirds the width of the front, and by sloping the back and splaying the sides, as shown in the illustration. The sides and back of the fireplace should be built of good fire brick set in fire clay.

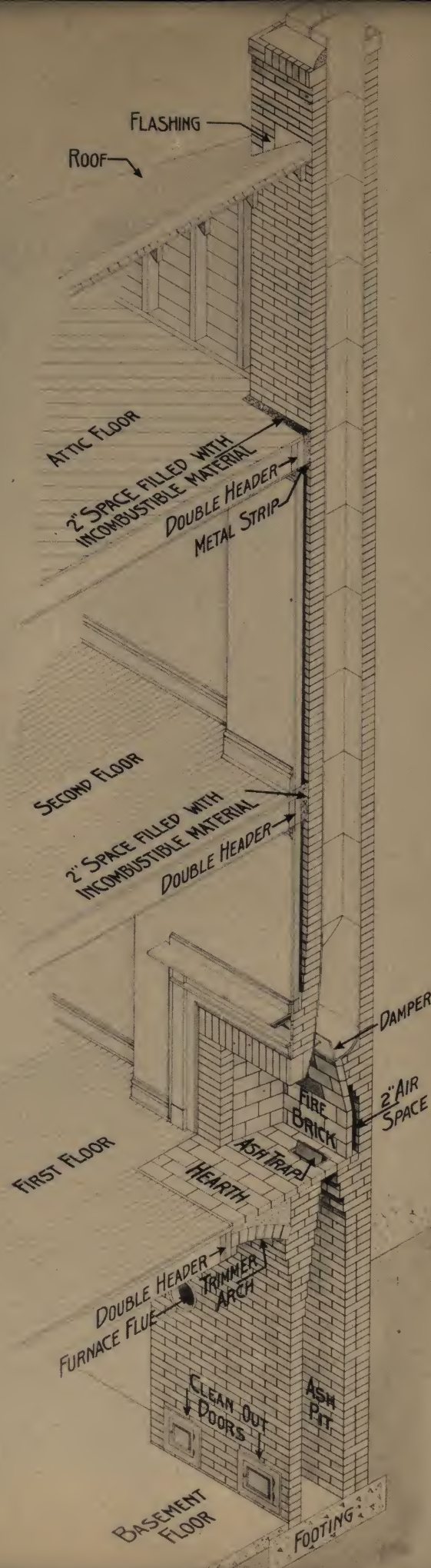
Fourth—the iron throat and damper should be of proper size and correctly located. The throat and damper should extend over the entire width of the fireplace.

Fifth—a properly constructed smoke shelf and smoke chamber should be provided.

The smoke shelf is formed by setting back the brickwork at the top of the throat. It should be the full width of the throat and not less than 4 inches wide. Eight to 12 inches is still better. Its purpose is to deflect the down draft.

The smoke chamber is the space from the top of the throat to the bottom of the flue. This space is necessary to hold the smoke temporarily when a gust of wind across the top of the chimney momentarily cuts off the draft. Otherwise, the smoke would be forced into the room. The walls of the smoke chamber should be plastered smooth.

Sixth—the chimney should be carried high enough above the house to insure a good draft.



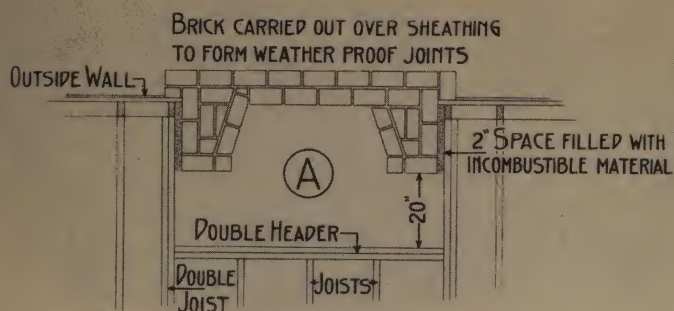


Fig. 42

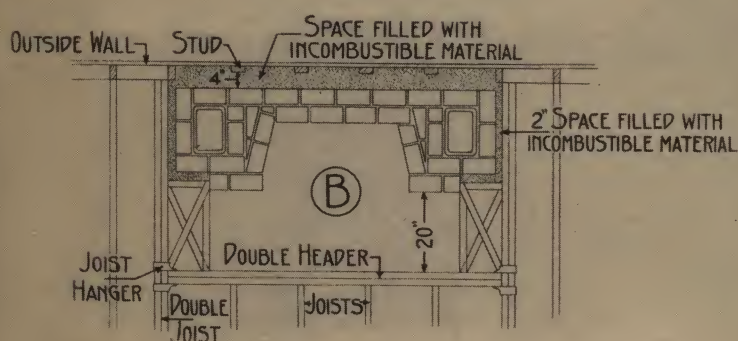


Fig. 43

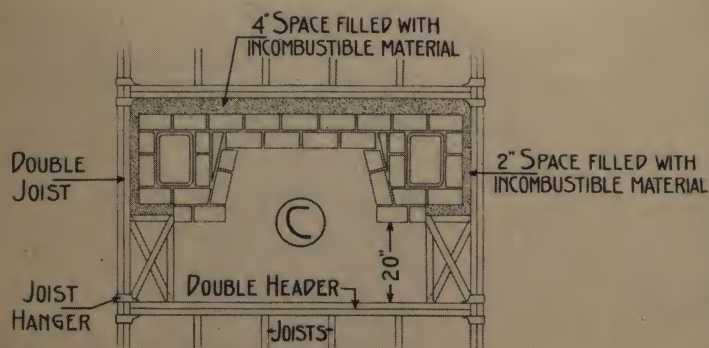


Fig. 44

● These drawings show the methods of floor framing around fireplaces built under the following conditions:

Figure 42—Fireplace partly exposed on outside of building.

Figure 43—Fireplace built against outside wall but not exposed.

Figure 44—Fireplace inside of house having wood floor framing on all sides.

The principle applied in each case is the same. All framing members on the sides of the fireplace should be at least 2 inches away from brick or masonry wall, unless protected by 8 or more inches of brickwork or 12 inches or more of masonry. The intervening space should be filled with incombustible material such as mineral wool, concrete or mortar.

The framing at back should be at least four inches away, and the intervening space at each floor filled with incombustible material. The back should be at least 8 inches thick and lined with fire brick.

The header-joists or beam supporting the trimmer arch in front of a fireplace should be not less than 20 inches from the chimney breast. The hearth should be not less than 4 inches thick and should extend at least 20 inches in front of the fireplace. The woodwork around the fireplace should be not nearer than 8 inches at the sides of the opening and 12 inches at the top.

The incombustible material used for filling between the framing members and the brickwork should be supported by strips of sheet metal or metal lath set into brickwork and nailed to the joists with a buckle joint to allow for the settling of the chimney.

Note in Figure 42 the method of weatherproofing the joint between the brickwork and the frame wall.

THE ROOF

ROOF PITCH. Insufficient pitch probably causes more troublesome roofs than any other single factor, especially in climates where there is considerable snow. It is difficult to build a tight roof of low pitch in these localities. In climates where the snowfall is very heavy, the pitch should be not less than one-third. Home builders, in the climates where deep snows are customary, will also do well to hold to simple, straight roof lines.

RAFTERS

THE roof rafters, the framing members of the roof, must be of sufficient size and strength to support the weight of the roof, to carry the snow load and to resist the wind pressure without sagging. If the rafters are undersized or spaced too far apart, they will sag. This sagging will split and loosen the shingles and cause a leaky roof.

ROOF SHEATHING

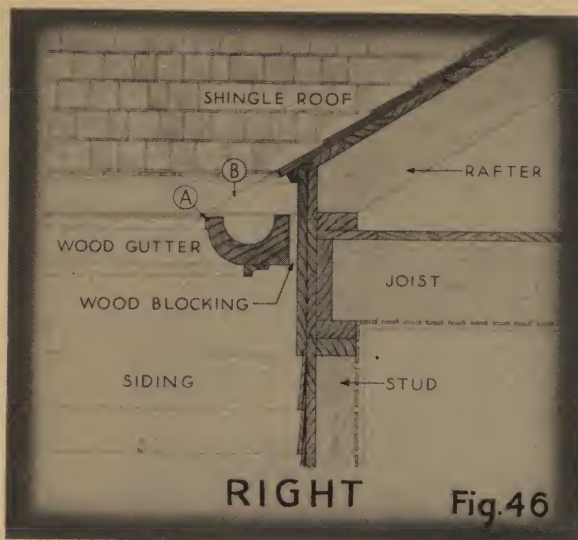
ROOF sheathing boards give best results when laid tight. As the roof boards are depended upon for some bracing effect as well as to furnish the foundation for the roof covering, the joints should be staggered. All roof boards should be nailed with at least two 8-penny nails at each rafter. Boards wider than six inches require at least three nails. If the third floor of the house is to be occupied, the roof should be insulated in the manner suggested in the following chapter. Oven-like attics are the result of the hot summer rays of the sun beating down upon an uninsulated roof and can be avoided at slight cost. The dollars wasted in heat lost through the average roof in winter



● This is a familiar sight where snow and ice are the rule during the winter and early spring.

The valley formed by a gable on the side of the main roof becomes filled with drifting snow. Mild days and the heat lost through the roof causes the snow to melt and when followed by a drop in temperature at night, the downspout becomes clogged with ice.

When the water from the next day's thaw freezes, the entire gutter becomes filled with ice. Unless the gutters are of proper design, the valley will next become filled with ice and the water from further melting of the snow will, in its downward course, back up under the shingles and damage is done.



Wood gutters have much in their favor which makes their use desirable in good construction.

The above illustration shows the correct method of installing a wood gutter. Note the blocks, spaced three feet apart, behind the gutter which provide openings for overflow in case the downspouts become clogged.

would, in a short time, pay for the cost of insulation.

SHINGLES

FOR the average house, there is no better nor more economical roof covering than wood shingles, properly applied. The following specifications will assure a tight, durable roof:

For best results use edge grain shingles measuring not less than five shingles to two inches in thickness, measured at the butts or thick ends. (In edge grain shingles the annual rings show as approximately vertical lines in the end section.) Shingles are made in 16, 18 and 24-inch lengths. The 18 and 24-inch shingles can be laid safely with larger weather exposure and can be laid more rapidly. All shingles over 9 inches wide

should be split before laying. Use only two nails for each shingle.

Lay first course 2 ply, allowing from 1 1/4 to 2 inches projection over crown mold and 1 inch projection at gables. Shingles should be spaced approximately 1/8-inch apart. Do not drive the heads of the nails into the shingles. Break joints not closer than one and one-fourth inches, side lap. See that breaks do not come directly over each other on any three consecutive courses. The covering of all nails is essential for a serviceable roof.

NAILS

A SHINGLE roof cannot last longer than the nails that hold it. It is not in the least uncommon for shingles to outlive the shingle nails. The ordinary shingle nail rusts and breaks off long before the shingles themselves begin to deteriorate. If, then, the life of the roof is so dependent upon the life of the nails used, there is surely no extravagance in using the best nails obtainable.

Hot dipped, zinc-coated or copper nails make the best shingle nails. While they naturally cost more, the cost of shingle nails is such a small item in the building of a house that, even doubled, it amounts to very little. Certainly the best shingle nails obtainable are a good investment if they double the life of the roof.

GUTTERS

A WELL-BUILT gutter of proper design is essential to the tight roof. It is a common sight in northern climates to see deep drifts of snow on the roof. A properly designed gutter permits the snow to slide off over it. Other essentials of the good gutter include sufficient size and enough pitch or slope to carry the water off rapidly.

MAKING THE WALLS WEATHERPROOF

THE making of a weatherproof house, no matter what material is used for wall covering, starts with proper wall construction. If the joints around the doors and windows and other points are not tight, good construction in the rest of the wall will not make the house cool in summer nor easy to keep warm in winter. A number of these points are discussed in Figures 30, 31 and 49.

INSULATION

INSULATION is essential to good home construction. Insulation is a key to inside comfort—winter and summer—and pays actual dividends by cutting fuel bills. The saving in fuel will usually pay for the cost of good insulation in from three to five years.

Insulating materials on the market today may be divided into four classifications: flexible, rigid, fill, and reflective. The first three are composed of a large number of small cells amounting to minute dead air spaces which resist the passage of heat or cold. The fourth, as the name implies, depends on reflection of radiated heat for results.

Regardless of the type used, there are six important requirements for permanently effective insulating material.

First — HIGH EFFICIENCY, which is measured in the degree of resistance to passage of heat. Laboratory tests may not be relied upon entirely since test conditions and job conditions are not identical and increasing the thickness of an insulating material does not produce returns directly proportional. However, conductivity figures as

published by the American Society of Heating and Ventilating Engineers may be used as a guide to the value of an insulating material.

Second—MOISTURE PROTECTION. Insulation should be protected against the penetration of moisture. There is a marked difference in temperature inside and outside the house in some seasons, and somewhere within the walls moisture must condense. If that moisture is absorbed by the insulating material, serious damage to plaster and interior finish may result. It is not enough for the individual fibres of the insulating material to be waterproof. Moisture protection of an insulating material is becoming increasingly important with the progress of air conditioning and heating equipment which control inside temperatures and humidity.

Third—PROTECTED AGAINST AIR INFILTRATION. Some insulating materials lose efficiency because of their porous nature. Infiltration of air is a condition met to some degree in buildings of any construction (frame, brick, etc.). Efficient insulation should be permanently protected from air infiltration if it is to provide lasting satisfaction.

Fourth—FOOLPROOF AND PERMANENT APPLICATION. Settling of insulation results in increased density of the material, which reduces efficiency and exposes open spaces at the top of walls, leaving areas without insulating protection. When applied in the walls or ceiling of a building, insulation, to be permanently effective, should remain in place.

Fifth—PERMANENT. A known record of permanent satisfaction is the best reference any insulation can have. Its fundamen-

tal purpose is to provide permanent satisfaction and fuel economy.

Sixth—FIRE RESISTANT. An insulating material should not add to fire hazard. On the other hand, fire underwriters offer no insurance advantage to any type of construction in which fireproof insulation is used. Balsam-Wool Sealed Insulation (product of Weyerhaeuser), which is available in several thicknesses, meets all six require-

ments for effective insulation as well as, or better than, other products. Figure 52 illustrates the proper application of insulation. If the directions given are carried out, uniformly satisfactory results will follow. Insulation in the ceiling of a house is of major importance, and wall insulation follows as a close second in importance for economy and comfort looked for as a result of insulation.

● Below are shown three methods of constructing and fitting window frames. The point to be stressed is that of sealing up the joints around the window frame.

Figure 47 shows the type of window frame that permits of sealing up these joints most effectively. Here blind casings are used at the sides and top on both the outside and inside of the frame. These casings are nailed to the window studs at the sides and to the headers at the top of the opening. The wall sheathing butts against the edge of the outside blind casing, and the joint between the two is sealed by means of the building paper and outside finish casing. The inside blind casing acts as a gauge for the plaster which is worked up to it, the joint between the two being concealed by the inside finish casing.

The space between the sill and the header is filled with caulking material and further closed up with a strip plowed into the sill. The top of the sill is rabbeted to receive the sash and the siding is let into a groove in the under side.

It is also important that the joint between the drip caps (the moulding across the top of the frame) and the siding be made absolutely tight. This is accom-

plished by the use of flashing nailed to the drip cap and bent to extend up behind the siding.

Figure 48 shows the same frame except for the inside blind casing and the strip under the sill, both of which have been omitted. It is not as efficient as the method shown above but can be made very effective if put in with care.

Figure 49 illustrates the most common type of frame and the one that is responsible for the condition shown in Figure 51. When this frame is used, a hole is cut in the wall sheathing large enough to allow the frame to fit loosely. This leaves an opening the full height of the window on both sides, varying in width from one-half inch to an inch and with nothing but the joint between the outside casing and blind stops to protect it.

The sill is not rabbeted to receive the sash. The space between the sill and the header in the haphazard type of construction is usually not caulked but is left open to the ready passage of cold air and dust.

While these illustrations show frames for ordinary, double-hung sash, the same general principles apply to the construction and fitting of frames for stationary or casement sash.

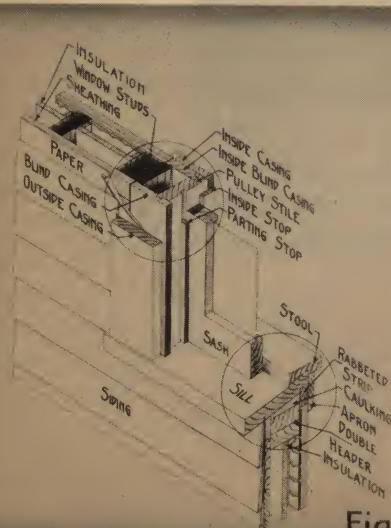


Fig.47

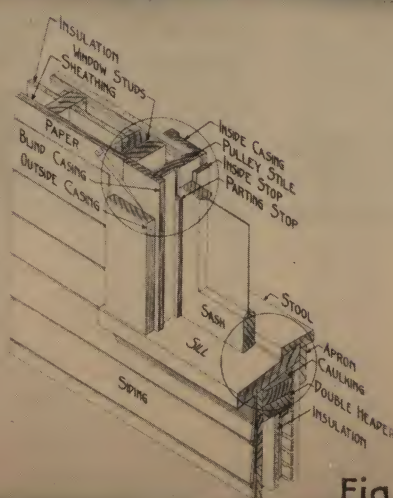


Fig.48

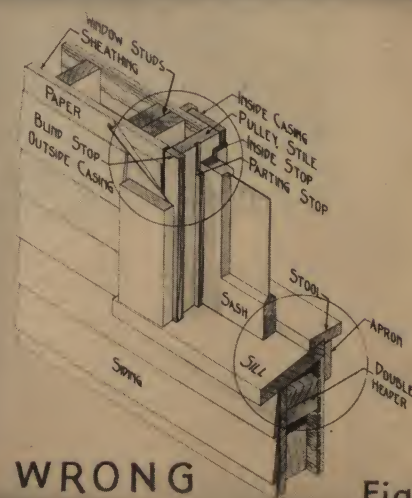


Fig.49

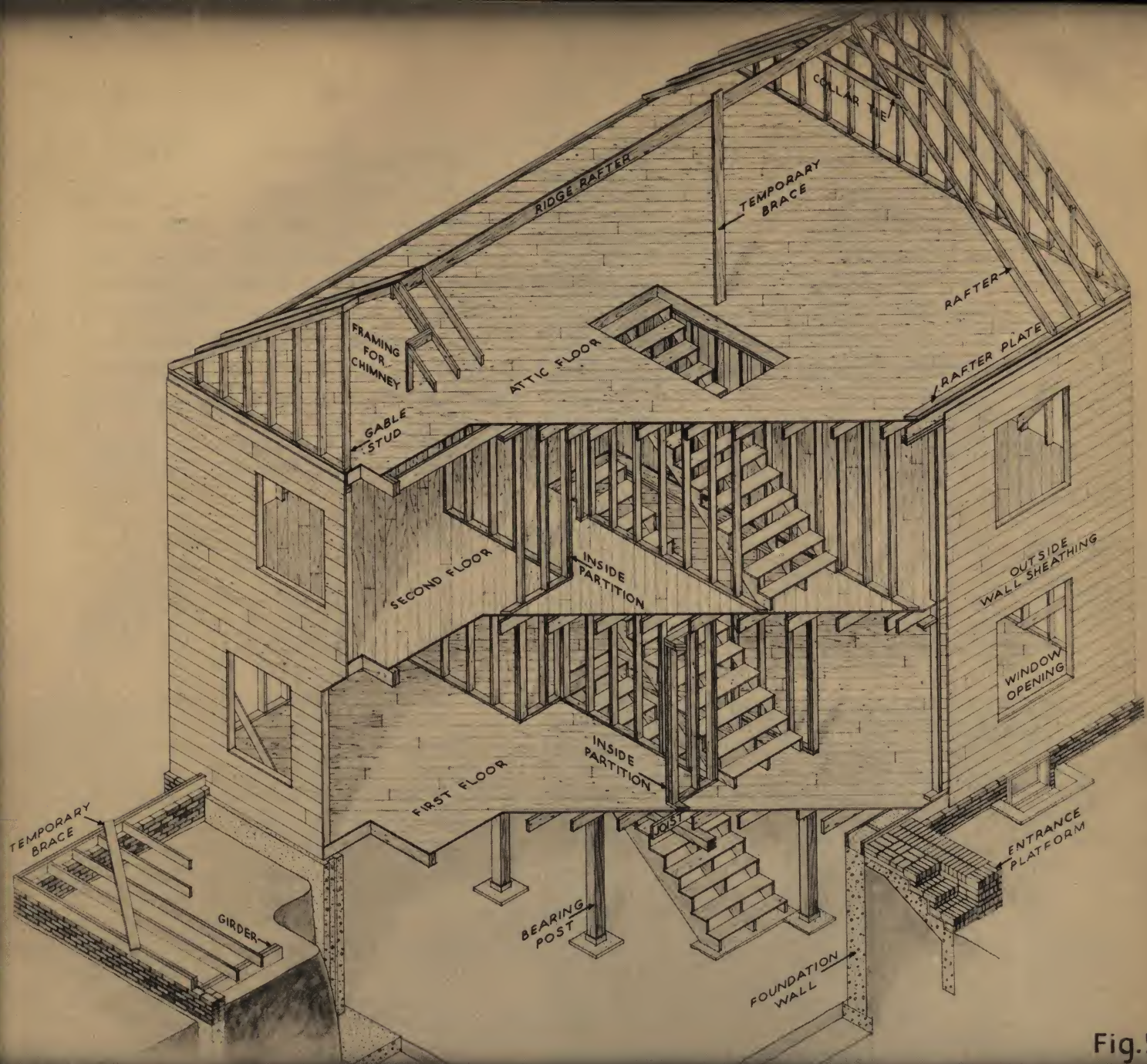


Fig.50

● Showing the usual method of procedure in Balloon Frame house construction. Previous drawings in this series appear on pages 10, 22, 26 and 37. The openings for the second story windows are cut and framed in, and the attic floor joists, with the necessary framing around stair and chimney openings, bridging and attic floor are shown here in place. The wall sheathing is then put on up to the attic floor line.

The ridge rafter and roof rafters are laid out and cut to the required length, after which the ridge rafter and a pair of rafters are set up. The gable studs at each end of the building are next fitted into place. The balance of the rafters are then put in and the opening cut for the chimney. The chimney is usually built before the roof boards are put on. Next, the rough framing for the porches is done.

STORM DOORS AND WINDOWS

IN those sections of the country where low temperatures prevail three or four months during the year, fuel bills can be materially reduced by the use of properly fitted storm doors and windows. The cost of this equipment also can be saved many times over during the life of the house through lower fuel bills.

METAL WEATHER STRIPS

METAL weather strips, when properly applied, prevent cold air from coming through the cracks around doors and windows and thus effect a saving in fuel bills. In localities with extremely low temperatures and strong winds, the use of both weather stripping and storm doors and windows will be found most satisfactory, as well as most economical.



● The use of building paper between the outside window casing and the wall sheathing, careful fitting of the sheathing around the opening and a well made window frame would have prevented the wind and dust from coming in at the sides of the window. See page 48.

The water stains below the window could have been avoided if the construction was like that shown in Figure 47 or 48. Figure 49 shows faulty construction.

● The method of applying insulating material between the studs is illustrated in this drawing.

The material is formed with a flange along each edge and these flanges are fastened to the studs, fire-stops and plates with nailing strips, usually wood lath.

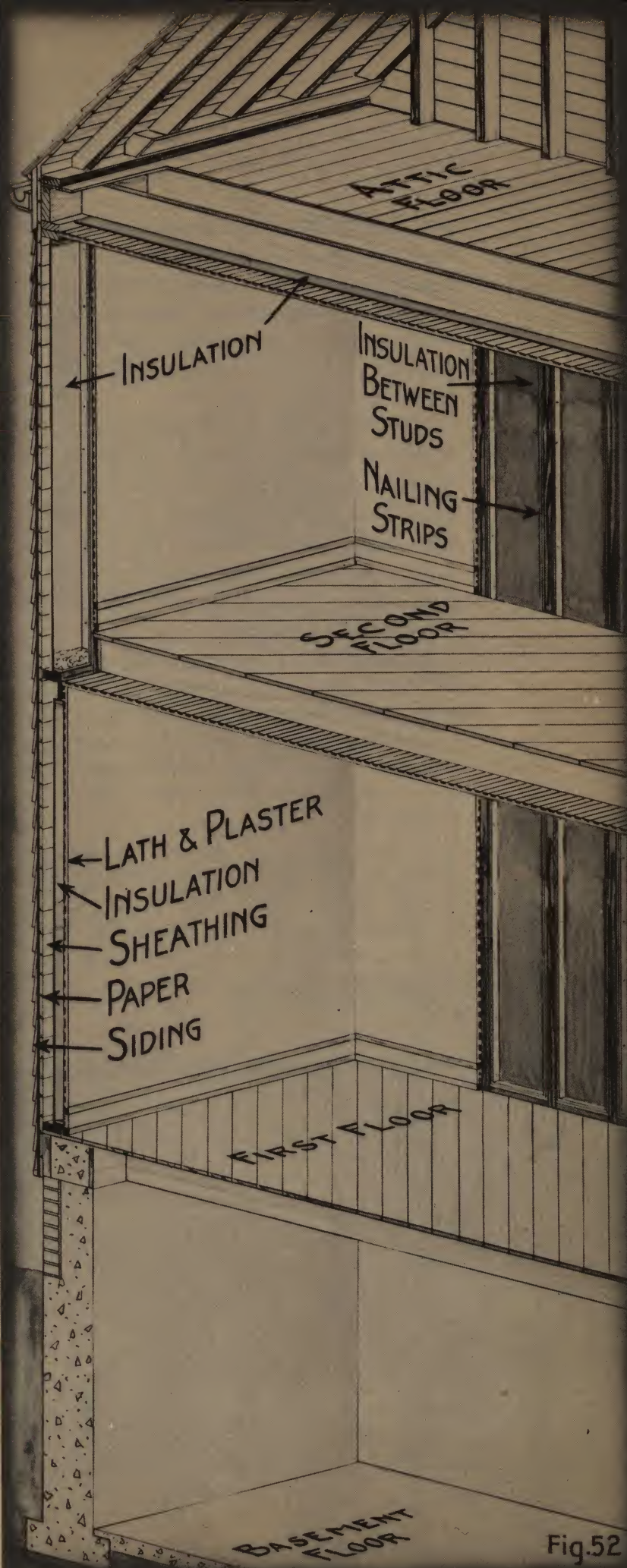
Several types of good insulation are available. Weyerhaeuser has developed the flexible type in the belief that it possesses superior features of efficiency. For specific references see page 47.

Note how the insulation divides each wall compartment into two air spaces, thus making it more difficult for heat and cold to penetrate the walls. More important still, the insulating material itself contains innumerable small air cells that further increase the resistance to the passage of heat and cold.

On the second floor, where the flooring and joists make it impossible to fasten securely the lower ends of the insulation, loose insulating material should be packed in, as shown, to insure a good joint.

While this drawing shows the insulation applied beneath the attic floors, this is not the proper application for all cases. Where the third floor is to be used for living quarters, the insulation should be run up the rafters, applied either between them or nailed to the inside faces and over the ceiling joists of the rooms finished off. The same principle applies in insulating the story-and-a-half house.

It is apparent from this drawing that the construction which makes a house fire-safe also makes thorough insulation easier.



PLASTER

PLASTER is not elastic, and regardless of the type of lath used with it, it will crack if there is any decided settlement or movement in the framing that holds it. The first essential, then, to a successful job of plastering is that the frame of the house be rigid.

The lath should be of good quality. A space not less than $\frac{3}{8}$ -inch should be left between the lath, and each lath should be nailed to each stud, preferably with 3-penny wire nails. Joints between the lath ends should be broken every seventh or eighth lath, and the ends of the lath should *not* be fitted tightly together.

No joints should occur directly over the corner of an opening. Lath should not run over or behind any partition; studs or well-braced backing strips should be arranged so that lath can be firmly nailed at each corner. A method of doing this is shown in Figure 53.

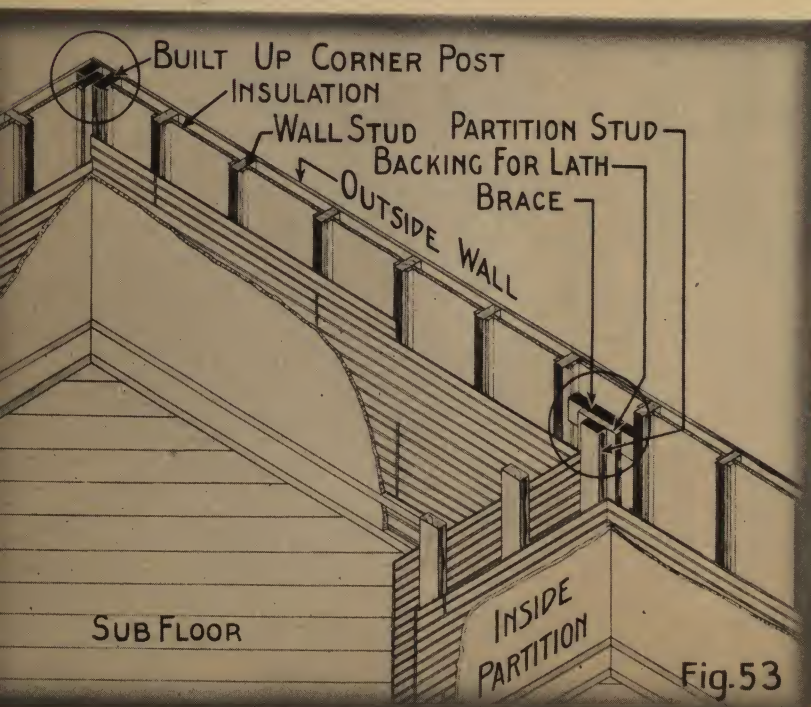
Ground strips of substantial material should be set straight and firmly nailed around all openings; these strips set the gauge for the thickness of the plaster. They are of assistance in getting a straight wall and are also valuable in securing an even,

straight surface for the trim. Metal corner beads should be used on all projecting corners.

Before the first coat of plaster is applied, it is very essential that the lath be wet thoroughly; dry lath will absorb the moisture from the plaster, thus causing the lath to swell and hence preventing the plaster from setting properly. Many builders prefer that the lath be green.

The fourth essential is good plaster, properly applied. There are a few points which should have special consideration to assure a good job. The first coat of plaster should be forced between the lath so that when it sets it will have formed a "clinker." This coat is usually allowed to dry thoroughly before the next one is put on. The wall should then be wet down again before the application of the second coat.

A simple understanding of the various reasons for cracked plaster in a house will go far towards enabling the home-builder to protect against it.



● This shows a method of securing proper backing for lath in cases where the inside partition joins the outside wall between two of the outside wall studs. A 1x8-inch board, known as "backing," is nailed to the back side of the end partition stud to receive the lath on the outside wall, and this is backed and held firmly in place by 2x4-inch braces placed between the wall studs.

When the partition runs parallel to the ceiling joists, a similar board is placed on top of the top plate. The corner post in this case is made of three 2x4's, the center one being set out far enough to secure a good nailing surface for the lath.

Fig. 53

INTERIOR TRIM AND FINISH FLOORS

THE pleasing appearance of interior woodwork and the satisfaction of having it "stay put" year in and year out depend so largely upon its treatment and the method of applying it as to merit consideration here.

Since the purpose of trim is to beautify, it should be well joined and pleasingly and appropriately finished. Satisfactory interior finish, like good plaster work, starts at the foundation footings. Uneven settling, due to those structural defects now familiar to the reader, is the greatest cause of unsightly openings and cracks in woodwork. A good job, however, is also dependent on the care the material receives before applying and the workmanship in placing it.

INTERIOR TRIM

INTERIOR trim (including the lumber used for base boards, picture and cornice mouldings, door and window casings, etc.) is seasoned and kiln dried before it leaves the factory and should be protected from water and moisture until it is in place. It should not be allowed to stand out in the

open after being delivered on the job, nor should it be brought into the house until after the plaster has dried. If it is allowed to absorb moisture, it will swell and warp, and if nailed when wet, unsightly cracks will develop as it dries out.

The trim is ordinarily nailed to the framing members. In places where there are no framing members to take the nails, nailing blocks of two-inch lumber are set into the walls before they are plastered to provide nailing surface for the trim. All trim should be well nailed.

It is especially necessary to have a tight joint between the window stool and the sill in order to keep rain and cold from entering. To effect this tight joint, the under side of the stool and the top of the sill, where they meet, should have a coating of good paint.

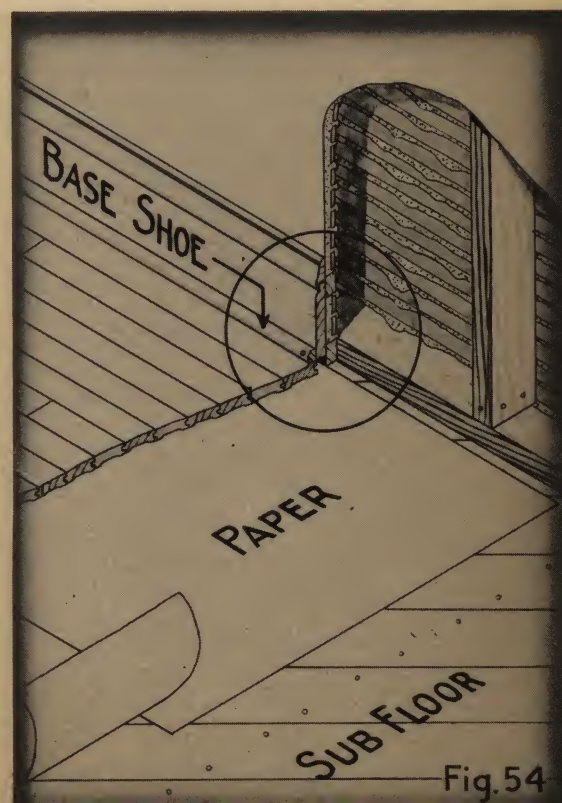
DOORS

THE care of doors before they are hung is just as important as the care of interior trim, and the same precautions apply to both. Furthermore, if troublesome doors

● The reader has undoubtedly often noticed unsightly cracks between the base shoe and floor or between the base shoe and the base board. These cracks are due to shrinkage of the floor members or the base board and can be avoided if the base shoe is nailed to the sub-floor instead of to the base board or finish floor.

To permit doing this, the finish floor boards should be kept the thickness of the base board away from the plastered wall on all sides of the room.

Long nails should be used for nailing the base shoe in place. The drawing within the large circle shows proper placing of finish floor boards at the walls and proper nailing of base shoe.



would be avoided, the top and bottom edge of each door should receive two coats of paint as the doors are hung. This prevents, to a large extent, the absorption of moisture that otherwise would cause the door to swell and bind.

Veneered doors are not adapted to places where they will be entirely exposed to the weather.

WINDOWS

THERE are several points in connection with the fitting of window sash that merit the attention of the home-builder. Balky windows that stick, first on one side and then the other, as one tries to open them, are often the result of loose fitting and present a situation difficult to remedy. Properly fitted windows in a new house, especially if they are in place during the time the plastering is being done, may bind a little until after the house has dried out, and until the woodwork has had time to adjust itself to the atmospheric condition in the completed house. If after a few months' time they continue to bind, this condition can then be quickly eliminated, provided, of course, that the construction around the

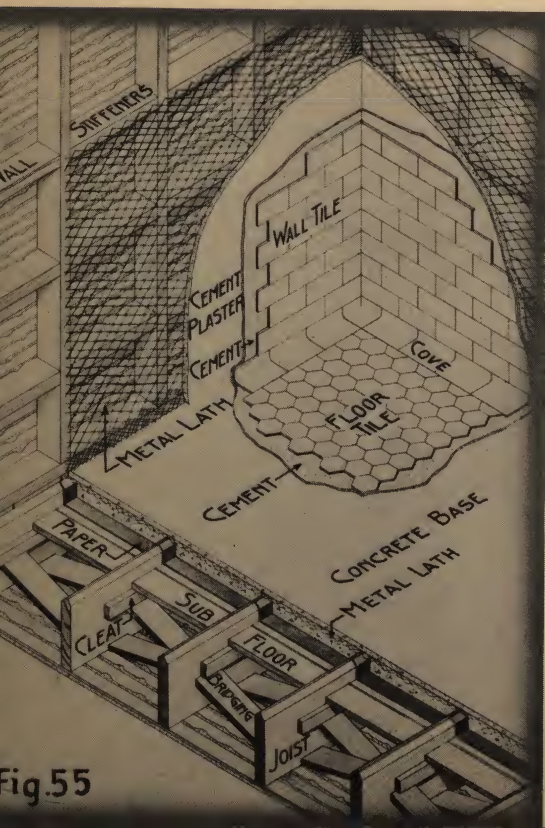
window frame is not the cause of the trouble.

Rattling windows are usually due to careless fitting of the window stops (the narrow strips which hold the lower sash in place). These stops should be held in place preferably by means of stop screws and washers, the holes in the stop being large enough to permit adjustment of the stop without entirely removing the screws.

The matter of making casement sash weatherproof is also deserving of careful attention. Any good builder who has had experience with casement sash can give you valuable advice on this subject.

FINISH FLOORS

AS has been said before, it is best to lay sub-floors diagonally. At any rate, the finish floor should be laid at an angle to the sub-floor and preferably at right angles to the joists. This reduces shrinkage to a minimum. Bulges and cracks in floors also result from poor nailing and failure to provide for floor expansion. Figure 54 shows the proper method of laying floors and also shows how to make them dust- and dirt-proof.



● The advantages of tile floors for the bathroom hardly need be pointed out. Good tile, properly applied on a foundation of sound framing, is essential to satisfactory tile work.

This picture illustrates one method of securing a substantial foundation for tiled floors and walls. The top of each joist is beveled off or chamfered. Boards are set between the joists, as shown, with a $\frac{1}{8}$ -inch space between them to allow for swelling.

This layer of boards should be covered with a good grade of waterproof building paper.

The joists should be braced every six feet with bridging. The concrete should be at least $2\frac{1}{2}$ inches thick, reinforced with metal lath, and should extend not less than $\frac{3}{4}$ inch above the tops of the joists, as shown.

Where the side walls are tiled, headers should be set between the studs at intervals of twelve to sixteen inches and the concrete base applied over metal laths securely nailed.

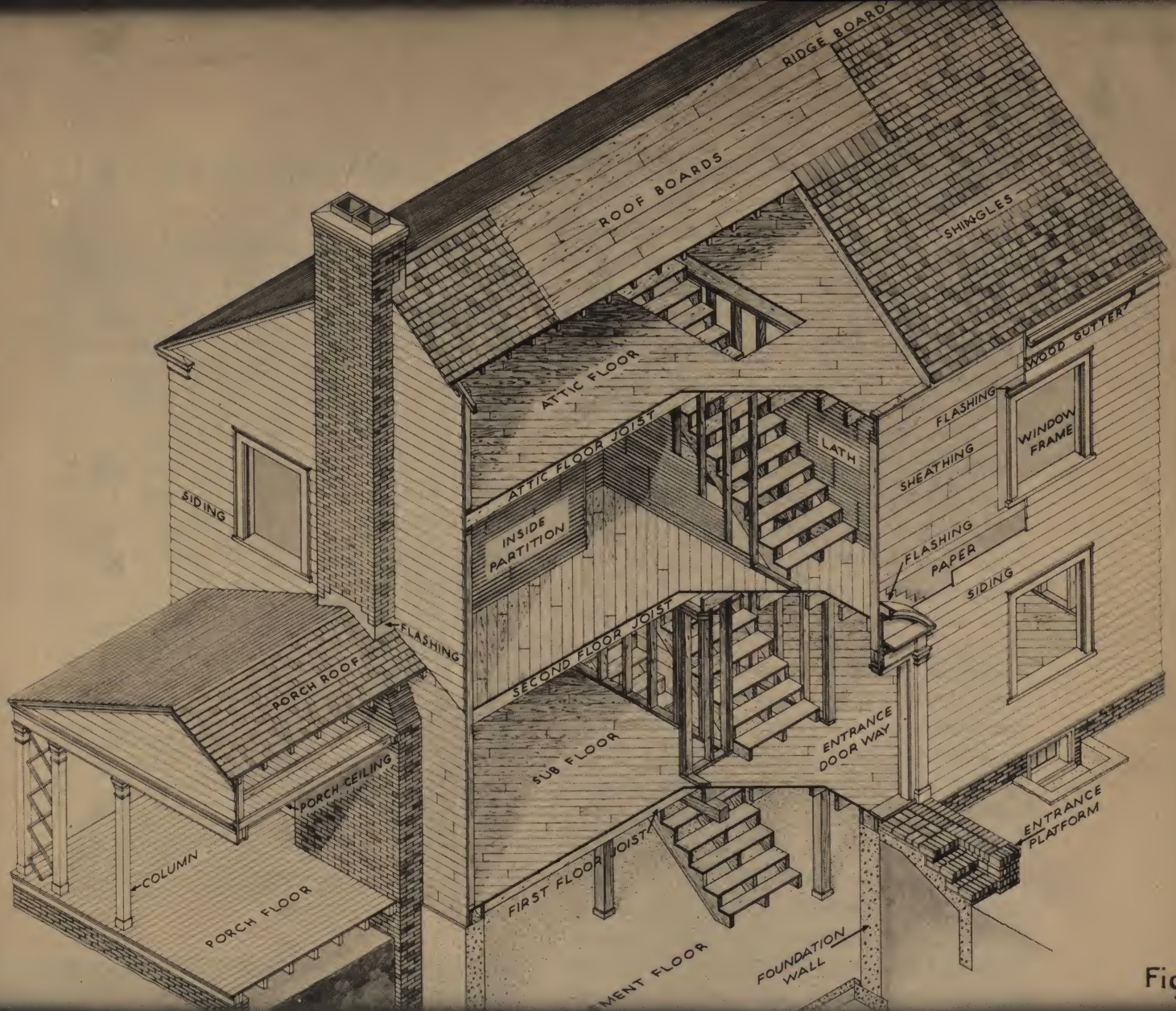


Fig.56

● This is the last of the series of illustrations showing a Balloon Frame house in various stages of construction. Other drawings in this series will be found on pages 10, 22, 26, 37 and 49.

After the work mentioned in Figure 50, page 49, is finished, the roof boards for the main and porch roofs are put on end and the shingles laid.

While this is being done, the plumbers and heating men are busy installing the pipes for this equipment.

The window and outside door frames are then set in, and the balance of the outside finish such as base, corner boards, if any, and frieze boards and siding are put on.

The interior of the house is next made ready to receive the lath and plaster. This includes nailing blocks and backing for lath

and all interior finish, plaster grounds for interior trim, fire-stops between the studs and other places not already provided for, and insulation between wall studs and ceiling joists. Lath is then applied after which the plastering is done.

While the lathers are at work inside, the carpenters usually finish up the work on the porches. This consists of laying the floors, finishing the porch beams, railings, columns, lattice work, and putting in the ceiling.

After the plastering has thoroughly dried, the interior finish lumber is taken into the building, filled and stained by the painter, and applied by the carpenter. The finish floors are laid last. This work completed, the trim hardware is put on, and finish coats of paint and varnish are applied inside and out.

THE EXTERIOR OF YOUR HOUSE

THE principles of correct construction practice apply alike to all houses. The construction of the framework is practically the same, regardless of whether the exterior is wood, stucco, or brick veneer. Upon good lumber properly used and accurate workmanship depends the ultimate success of the completed building. The selection of the exterior covering of your house will depend upon your architectural style.

WOOD SIDING

LUMBER is available in the form of siding cut to various patterns and in several thicknesses and widths. Siding is made in sizes ranging from 1/2-inch by 4 inches to 3/4-inch by 12 inches and is available in the correct species at practically any retail lumber yard.

The proper selection of the kind and grade of siding for outside wall covering is important. The outside of a house, subjected to sun and wind, rain and snow, receives its most severe usage. Exterior wood should be of a decay-resisting species that will hold tight at the joints and will take and hold paint. It should be thoroughly seasoned. The Weyerhaeuser organization has made available siding in the following species: Western Red Cedar, Idaho White Pine, Northern White Pine and Ponderosa Pine. Weyerhaeuser 4-Square siding is delivered to the building site in neat packages, the ends of which are protected with cardboard caps. The ends of each piece are cut perfectly square on precision machines. The face is smooth to receive paint. The edges are eased to permit better painting and insure against splinters during application.

In applying siding, all joints around win-

dow frames and corner boards or at mitred corners should be carefully fitted. Spliced joints should be absolutely tight to prevent the infiltration of moisture. 4-Square siding has found such universal acceptance because the ends are cut square at the mill, leaving no hand-fitting to be done on the job. No spliced joints in three consecutive boards should be directly over each other. Proper nailing, with the correct size of nail, is important. Nailing should always be directly over each stud. The nail heads should be set into the wood and the hole filled with putty after the first coat of paint is applied.

Siding and all other exposed woodwork should be given a coat of paint (called the priming coat) as soon as it is in place. If it has been rained upon after application, it should be permitted to dry out before any paint is applied. It is highly important that a good grade of paint be used.



Fig. 57

WALL SHINGLES

ONLY No. 1 Certigrade Western Red Cedar Shingles should be used for walls. These may be in lengths of 16, 18, and 24 inches. The exposures for the 16-inch may be 7½ inches to the weather; the 18-inch, 8½ inches to the weather, and the 24-inch, 11½ inches to the weather. Where a wide exposure with a deep shadow line is required, investigate the wisdom of using shingles applied by the double-coursing method. This merely means the outside shingle is of No. 1 quality and the shingle below is one of No. 2 or No. 3 grade. By using shingles in this manner, it is possible to extend the exposure of a 16-inch shingle up to 12 inches. Use rust-resisting hot dipped zinc coated nails or copper nails. Edham Stained Shingles, a Weyerhaeuser product, are made of edge grain Western Red Cedar and are thoroughly impregnated with enduring stain. Edham Stained Shingles are available in a wide variety of attractive colors which contribute admirably to beautiful, long-lived exterior treatments.

STUCCO

STUCCO, properly applied, in climates which are favorable, provides a satisfactory exterior. Its use should be avoided in sections where extremes of dampness or dryness are experienced. Some patented stucco products used have been unsatisfactory, so care should be exercised in selecting the materials. The following important rules should govern when a stucco exterior is desired:

1. Stucco should not come in contact with the ground. A solid concrete or brick base should extend at least six inches above the ground.

2. Proper overhang and drip should be provided for all window sills and other horizontal woodwork. Metal or wood stops should be provided. The tops of all window frames and horizontal strips should be covered with metal flashing.

3. Liberal use of flashing is suggested at the roof and wall intersection under joints of masonry, exterior trim, etc.

4. Chimneys should be covered with a concrete cap at the top. Chimney should be wrapped with metal lath.

5. Waterproof paper should be applied over the wall sheathing and under the metal lath.

BRICK

THE first requisite of good brickwork is good brick. Good face brick should be sound, free from cracks and flaws, uniform in size, with surfaces true and square to each other and with sharp angles and edges. The durability of brickwork is governed largely by moisture absorption; a good brick will not absorb more than one-tenth of its weight of water.

The second essential of good brickwork is good mortar. A rich mixture of mortar, one part cement to two parts of sand is recommended for all exterior brickwork.

The third requisite is good workmanship. The brick should be laid level with uniform mortar joints, carefully struck. Proper anchoring of the brickwork to the frame is done by the use of metal ties placed every other brick in every fifth course.

The observance of these points will minimize repair bills and avoid much later disappointment in the outside appearance of the house.

THE LUMBER TO USE FOR THE FRAMEWORK OF A HOUSE

IN the construction of a house from the pouring of the foundation footings to the nailing of the last piece of interior trim, good workmanship and good materials are absolute essentials.

For the sills of a house, or any member placed near the ground, sapwood of all species of lumber should be avoided. For all such places, heartwood should be used. In areas where termites have been found, it may prove wise to use a lumber which has been treated with a toxic material. If your builder follows one of the simple methods recommended by the United States Department of Agriculture, your home will not be troubled by termites.*

The essential requirements of lumber for the framework of a building are strength and proper seasoning to minimize shrinking after application. Today, with modern lumber mills producing lumber in many

kinds and grades, home builders have a wide range of suitable framing woods from which to choose.

Throughout the south, Southern Yellow Pine is the wood most commonly used for house framing. When properly manufactured of a correct grade and dried to reasonable moisture content, this wood in the hands of a competent mechanic makes strong, long-lived houses. In a few sections of the northern half of the United States, local woods provide material from which good house frames may be built. Throughout the rest of the country, Douglas Fir and West Coast Hemlock are considered the premier framing woods.

Douglas Fir exceeds in strength any other wood of like weight. Douglas Fir is easily dried, and because of the enormous size of the logs from which this species is produced, the amount of sap in that part used for framing is very small. It machines well, does not twist or warp, and has little tendency to check or split when properly dried.

*Leaflet No. 101. Superintendent of Documents, Washington, D. C. Cost 5 cents—coin not stamps.



WEYERHAEUSER 4-SQUARE GUIDE LINE FRAMING

NO framing material comes better recommended than Weyerhaeuser 4-Square Guide Line Framing. Each piece is cut to the exact length, making for speed in house erection. Both ends are trimmed smooth and square on high speed precision equipment, assuring tight fitting bearings wherever structural joints are necessary. Guide Line Framing is properly seasoned, which means a minimum amount of shrinkage

after the building has been erected. Each piece is grade-marked and trade-marked. Another feature of Guide Line Framing which has found favor with expert craftsmen is the foot and inch calibrations plainly marked on the face of each piece. These marks are used for accuracy by the craftsmen in cutting short framing members such as rafters and stair carriages.

4-SQUARE ENDLESS (End-Matched) LUMBER

THE lumber used for boxing or sheathing, after the framing has been erected, should have high nail-holding ability and be easy to work. These qualities should also apply to lumber for roof-sheathing and sub-flooring.

Weyerhaeuser produces a special type of wall sheathing, roof sheathing and sub-flooring. This material is known as 4-Square Endless Lumber and is made in several species. The principle of Endless or End-Matched Lumber is simple. It is tongued and grooved on sides and edges, and, therefore, it is not necessary to make joints on studs, rafters, and joists. Endless lumber may be used as it comes from the package, the tongue and groove fitted together to make a tight, unbroken surface. The surface resulting from the use of 4-Square Endless Lumber forms a tight, weather-resistant base for siding, shingles or finish floor. A distinct advantage in the use of this material is that it may be applied diagonally without waste, for the side-walls and sub-floors, thereby adding greatly to the strength of the frame.

ROOF SHINGLES

THERE is available today almost a limitless variety of roofing materials ranging

from inexpensive roll roofing to the finest of burned clay tile. In some sections of the country a slate roof can be applied at reasonable cost. Likewise, there are satisfactory tiles, both of clay and other products, which make long-lived, attractive roof coverings. A number of manufacturers are producing asbestos and cement shingles. When heavy roof coverings are used, it is of utmost importance that the roof framing be of a nature which will carry the loads imposed upon the rafters and other framing members.

For generations, wood shingles have proved their value as a permanent roof covering. Their natural beauty and heavy shadow lines also lend graceful, dignified charm to the home which finds no substitute. The most widely used wood for shingles of permanence is Western Red Cedar. When No. 1 Certigrade shingles are employed, you are assured a long-lasting roof.

Where the architectural style requires the use of colored shingles, there are a number of well-known brands of pre-stained shingles on the market, one of which is Edham Stained Shingles. The stain for these





● Exact Lengths

shingles is carefully compounded by expert chemists and applied by specially designed machinery. Only No. 1 Certigrade Shingles are used in the manufacture of the Edham product, and a carefully applied Edham roof, wherein proper nails and correct workmanship are used, provides the house with a beautiful, permanent roof.

Another factor which should be given consideration in selecting the roof for your house is the insulation value of wood shingles. Properly laid wood shingles provide a thick coating of Western Red Cedar which holds heat inside the house and reduces fuel bills.

YOUR CHOICE OF WOODS FOR INTERIOR WOODWORK

LUMBER for the interior of your home is used for doors, windows, floors, cabinet work, stairs and interior trim such as casings, base and picture mold.

Windows and doors, as well as the frames for them, are the products of sash, door and millwork factories and are available in various sizes, types and designs. This import-

ant part of the house has been standardized to a large degree. Stock or standard sizes of windows, doors, frames and trim can be used effectively and economically.

To the busy housewife, given a convenient arrangement and pleasant surroundings, nothing is more annoying than the swelling and shrinking or sticking and binding of cabinet drawers or cupboard doors. They require a wood that, when properly seasoned and properly joined and fitted, will "stay put" through all the many variations of temperature and humidity to which they may be subjected.

Idaho White Pine, Ponderosa Pine, Northern White Pine, and Douglas Fir are all suitable and satisfactory and all are easily adaptable to cabinet and fixture use.

Finish floors should be laid upon diagonally laid sub-floors and should be of hardwood or of some two or three species of softwood, carefully selected for vertical grain.

For finish floors in houses where first cost is an important consideration, vertical grain Douglas Fir is frequently used with satisfactory results.

For the interior trim of your home, for doors and window casings, base boards, picture and cornice moldings, etc., the need in lumber is for wood that works readily into the desired forms or patterns, that once in place will hold firmly at the joints and that will give the desired grain or finishing effects.

Being a part of your scheme of interior decoration, your interior trim may be finished in light tones, to harmonize with your wall and room decoration and in contrast to your darker furniture. It may be stained in darker tones to harmonize with your furniture and in contrast to your general scheme of wall and room coloring.

In the former instance, your scheme of room decoration determines the finish of your woodwork, permitting you free rein in your selection of furniture. In the latter case the finish of your woodwork sets precedence for your selection of furniture and limits your range of choice to that extent.

Of the various species manufactured by the Weyerhaeuser Mills and adaptable to painted or enameled interior work, Idaho White Pine, Ponderosa Pine, Douglas Fir, and Northern White Pine all merit consideration. For staining or finishing in the natural grain of the wood, these species and some others suggest interesting possibilities.

Your 4-Square lumber dealer is an expert in woods. He knows the economies in the selection of lumber for any purpose, and he stands ready to assist you, your architect and builder.

WALL PANELING

A VERY practical and popular use for lumber is in the form of wall paneling. For this purpose there are a number of highly satisfactory species available such as knotty White Pine, Ponderosa Pine, Douglas Fir and Western Red Cedar. Wall paneling may be molded on the edge prior to being used and distinctive rooms result. There are a number of patterns and species in various grades available through 4-Square dealers.

THE WEYERHAEUSER PLEDGE OF PERSONAL RESPONSIBILITY

FOR years it has been a part of the Weyerhaeuser ideal not merely to manu-



Fig. 61

● Square Smooth Ends

facture lumber, but give maximum value in every foot sold.

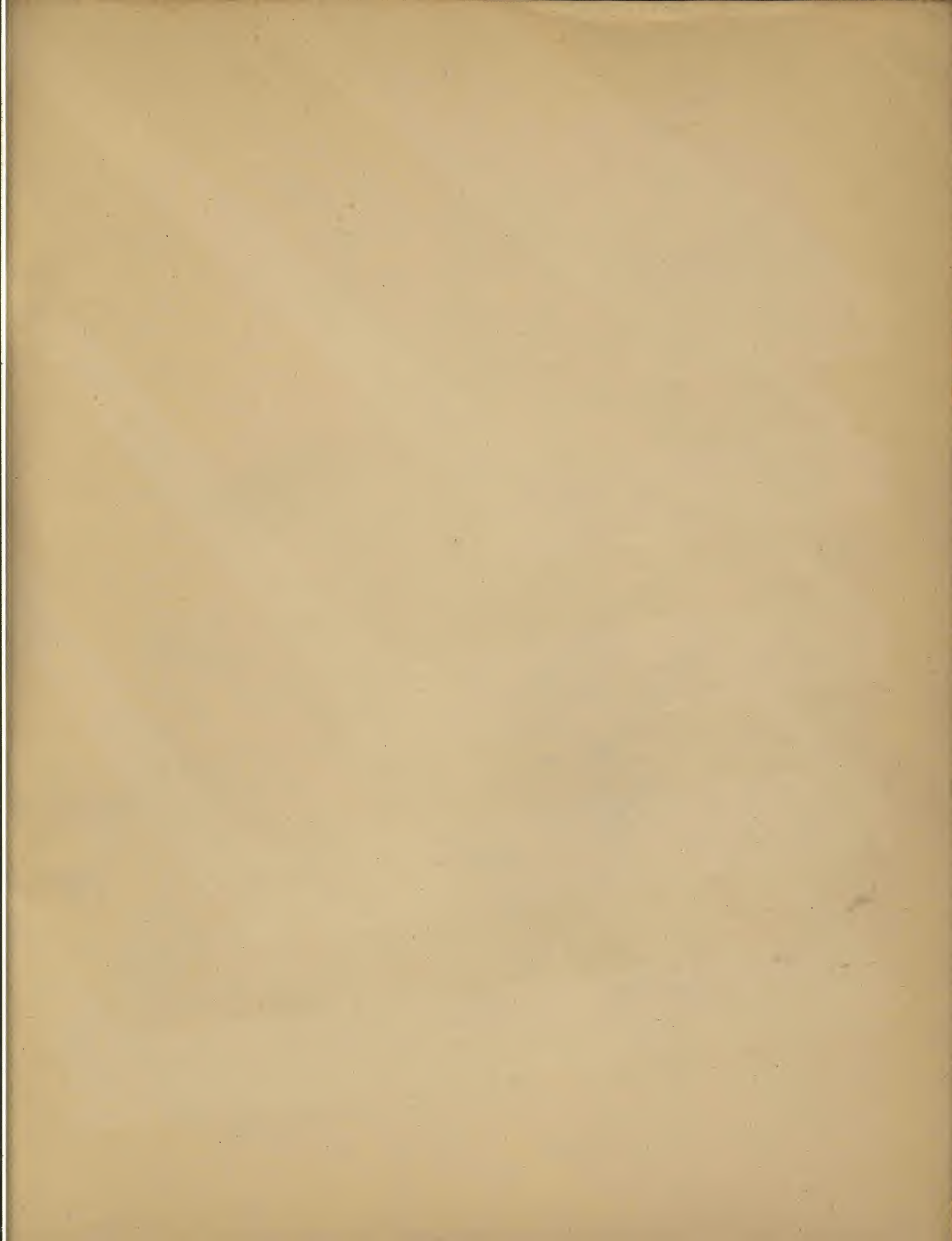
With an efficient plan, an attractive design and sound construction, one further consideration still remains: the lumber that you use should be carefully selected and properly dried. It must be protected during the process of seasoning. Extensive kiln drying and storage facilities must be available at points of manufacture. Minute attention must be given such details as the "stripping" of the cars before loading, in order that the lumber reaches your dealer's yard clean, bright and dry, ready for your use. Therefore, you will find the better class of contractors and builders using Weyerhaeuser 4-Square lumber.

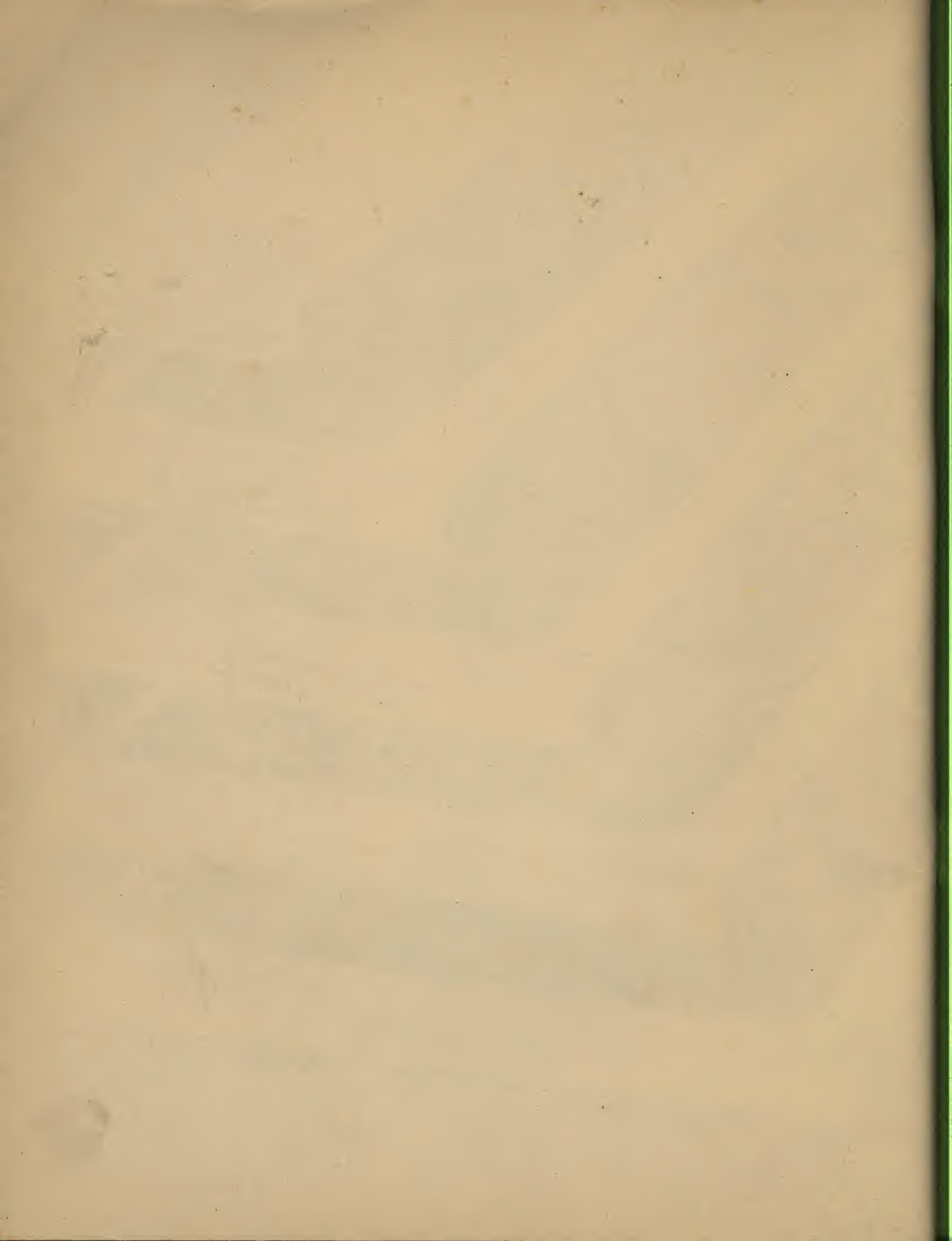
You will find, too, that retail lumber dealers everywhere are catching the spirit of the broad Weyerhaeuser policy of 100 per cent service value.

The Weyerhaeuser 4-Square trademark stamped on lumber is your assurance that the product will deliver the service expected of it. It is the personal pledge of the manufacturer.



Fig. 62







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